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(BAW—10074A(Rev.1))
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Influence of various diets on the radiosensitivity of guinea pigs, 1:17675 (ERDA-tr-110)
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SCHROEDINGER EQUATION
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CONTENTS

Category	Page
COAL AND COAL PRODUCTS	3939
PROCESSING	3939
CARBONIZATION	3939
DESULFURIZATION AND PURIFICATION	3939
GASIFICATION	3939
LIQUEFACTION	3942
PYROLYSIS AND CRACKING	3943
PROPERTIES	3944
WASTE MANAGEMENT	3944
ENVIRONMENTAL ASPECTS	3944
MINING	3945
TRANSPORT AND HANDLING	3947
COMBUSTION	3949
MARKETING AND ECONOMICS	3949
HEALTH AND SAFETY	3949
REGULATIONS	3950
PETROLEUM	3950
GEOLOGY AND EXPLORATION	3950
DRILLING AND PRODUCTION	3950
PROCESSING	3952
PRODUCTS AND BY-PRODUCTS	3952
MARKETING AND ECONOMICS	3952
WASTE MANAGEMENT	3952
ENVIRONMENTAL ASPECTS	3952
TRANSPORT, PIPELINES, AND HANDLING	3953
PROPERTIES	3954
COMBUSTION	3954
NATURAL GAS	3954
GEOLOGY AND EXPLORATION	3954
DRILLING, PRODUCTION, AND PROCESSING	3954
MARKETING AND ECONOMICS	3954
ENVIRONMENTAL EFFECTS	3954
ARTIFICIAL STIMULATION, PLOWSHARE, ETC.	3954
TRANSPORT, PIPELINES, AND HANDLING	3955
OIL SHALES AND TAR SANDS	3955
RESERVES AND EXPLORATION	3955
DRILLING, FRACTURING, AND MINING	3955
OIL PRODUCTION, RECOVERY, AND REFINING	3956
IN SITU METHODS, TRUE AND MODIFIED	3956
SURFACE METHODS	3956
REFINING	3957
PROPERTIES AND COMPOSITION	3957
HEALTH AND SAFETY	3957
ENVIROMENTAL ASPECTS	3957
NUCLEAR FUELS	3957
RESERVES	3957
EXPLORATION	3957
MINING	3959
FEED PROCESSING	3959
ENRICHMENT	3959
FUELS PRODUCTION AND PROPERTIES	3959
SPENT FUELS REPROCESSING	3961
TRANSPORT AND STORAGE	3961
WASTE MANAGEMENT	3962
WASTE PROCESSING	3962
WASTE DISPOSAL AND STORAGE	3963
ENVIRONMENTAL ASPECTS	3966
HEALTH AND SAFETY	3966
REGULATIONS	3966
ACCOUNTABILITY AND SAFEGUARDS	3966
ADMINISTRATIVE AND REGULATORY	3968
FUSION FUELS	3968
BY-PRODUCTS	3968
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	3968
RADIATION SOURCES	3968
DESIGN AND FABRICATION	3968
OTHER INDUSTRIAL USES	3968
ISOTOPIC POWER SUPPLIES	3969
DESIGN AND FABRICATION	3969
HYDROGEN	3969
PRODUCTION	3969
ELECTROLYSIS	3969
BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES	3969
COAL GASIFICATION	3969
PROPERTIES	3969
OTHER SYNTHETIC AND NATURAL FUELS	3970
HYDROCARBON FUELS	3970
PROPERTIES	3970
PREPARATION	3970
CHEMICAL SYNTHESIS	3970
PREPARATION FROM WASTES OR BIOMASS	3970
ALCOHOL FUELS	3971
PREPARATION	3971
CHEMICAL SYNTHESIS	3971
PREPARATION FROM WASTES OR BIOMASS	3971
PREPARATION	3971
SOLID WASTE FUELS	3971
HYDRO ENERGY	3971
RESOURCES AND AVAILABILITY	3972
SITE GEOLOGY AND METEOROLOGY	3972
PLANT DESIGN AND OPERATION	3972
REGULATIONS AND LICENSING	3973
ECONOMICS AND MANAGEMENT	3973
ENVIRONMENTAL ASPECTS	3974
LAND USE AND AESTHETICS	3974
SOLAR ENERGY	3974
RESOURCES AND AVAILABILITY	3975
ECONOMICS	3975
ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS	3975
SOLAR ENERGY CONVERSION	3976
PHOTOVOLTAIC CONVERSION	3976
BIOMASS PRODUCTION AND CONVERSION	3979
PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION	3980
PHOTOVOLTAIC POWER PLANTS	3980
SOLAR THERMAL POWER PLANTS	3980
CENTRAL RECEIVER	3980
TOTAL ENERGY AND HYBRID SYSTEMS	3980
OCEAN THERMAL GRADIENT POWER PLANTS	3980
SOLAR RADIATION UTILIZATION	3981
SPACE HEATING AND COOLING	3981
AGRICULTURAL AND INDUSTRIAL PROCESS HEAT	3987
WATER HEATING	3987
SOLAR COLLECTORS AND CONCENTRATORS	3987
HEAT STORAGE	3988
GEOTHERMAL ENERGY	3989
RESOURCE STATUS AND ASSESSMENT	3989
GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS	3989
USA	3990

Category	Page
NON-USA	3990
GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY	3990
GEOPHYSICAL TECHNIQUES AND SURVEYS	3990
GEOCHEMICAL TECHNIQUES AND SURVEYS	3991
EXPLORATORY DRILLING AND WELL LOGGING	3991
ECONOMIC AND FINANCIAL ASPECTS	3991
ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL	3991
GEOTHERMAL POWER PLANTS	3991
DESIGN AND OPERATION	3992
POWER PLANT SYSTEMS AND COMPONENTS	3993
GEOTHERMAL ENGINEERING	3993
DRILLING TECHNOLOGY AND WELL HARDWARE	3993
CORROSION, SCALING, AND MATERIALS DEVELOPMENT	3993
GEOTHERMAL RESERVOIR AND WELL PERFORMANCE	3993
RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY	3993
DIRECT ENERGY UTILIZATION	3994
GEOTHERMAL DATA AND THEORY	3994
PROPERTIES OF MINERALS AND ROCKS	3994
TIDAL POWER	3994
TIDAL POWER PLANTS	3994
DESIGN AND OPERATION	3994
WAVE ENERGY CONVERTERS	3994
WIND ENERGY	3995
AVAILABILITY (CLIMATOLOGY)	3995
ECONOMICS	3995
WIND ENERGY ENGINEERING	3995
APPLICATIONS	3995
TURBINE DESIGN AND OPERATION	3995
SITE CHARACTERISTICS	3995
ELECTRIC POWER ENGINEERING	3995
POWER PLANTS AND POWER GENERATION	3995
COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS	3996
POWER CYCLES	3997
WASTE-FUELED SYSTEMS	3997
COMPONENTS	3997
ECONOMICS	3998
OFF-PEAK ENERGY STORAGE	3998
FUELS	3998
ENVIRONMENTAL ASPECTS	3998
THERMAL EFFLUENTS	3999
NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL	3999
SITE SELECTION AND LAND USE	4000
POWER TRANSMISSION AND DISTRIBUTION	4000
AC SYSTEMS, EHV AND UHV	4001
DC SYSTEMS	4001
SUPERCONDUCTING AND CRYOGENIC SYSTEMS	4001
NUCLEAR POWER PLANTS	4002
POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED	4002
POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED	4003
POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED	4004
POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED	4004
POWER REACTORS, BREEDING	4006
POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE	4011
REGULATION AND LICENSING	4011
PROCESS HEAT REACTORS	4011
NUCLEAR REACTOR TECHNOLOGY	4012
THEORY AND CALCULATION	4012
COMPONENTS AND ACCESSORIES	4014
FUEL ELEMENTS	4016
CONTROL SYSTEMS	4016
ENVIRONMENTAL ASPECTS	4017
SITING	4017
RADIOACTIVE EFFLUENTS	4018
CHEMICAL AND THERMAL EFFLUENTS	4020
RESEARCH, TEST, AND EXPERIMENTAL REACTORS	4020
PLUTONIUM AND ISOTOPE PRODUCTION REACTORS	4020
PROPULSION REACTORS	4021
REACTOR SAFETY	4022
ENERGY STORAGE	4026
MAGNETIC	4026
PUMPED HYDRO	4027
FLYWHEELS	4027
THERMAL	4027
BATTERIES	4027
DESIGN AND DEVELOPMENT	4028
PERFORMANCE AND TESTING	4028
MATERIALS, COMPONENTS, AND AUXILIARIES	4028
ENERGY MANAGEMENT AND POLICY	4029
ENERGY ANALYSIS AND MODELING	4029
ECONOMICS AND SOCIOLOGY	4030
ENVIRONMENT, HEALTH, AND SAFETY	4031
NATURAL RESOURCES	4031
RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION	4032
NUCLEAR ENERGY	4033
TRANSPORT AND STORAGE	4033
WASTE HEAT UTILIZATION	4033
CONSERVATION	4033
SUPPLY, DEMAND, AND FORECASTING	4034
POLICY, LEGISLATION, AND REGULATION	4035
FOSSIL FUELS	4036
COAL	4036
PETROLEUM	4036
HYDROGEN AND SYNTHETIC FUELS	4036
ELECTRIC POWER	4036
ELECTRIC POWER GENERATION	4037
ELECTRIC POWER TRANSMISSION AND DISTRIBUTION	4037
CONSUMPTION AND UTILIZATION	4038
UNCONVENTIONAL SOURCES AND POWER GENERATION	4038
SOLAR	4038
GEOTHERMAL	4038
OTHER	4038
ENERGY CONVERSION	4038
MHD GENERATORS	4038
DESIGN AND DEVELOPMENT	4039
PERFORMANCE AND TESTING	4039
MATERIALS, COMPONENTS, AND AUXILIARIES	4040
DUCT ENGINEERING AND FLUID DYNAMICS	4042
MATERIALS, COMPONENTS, AND AUXILIARIES	4043
THERMIONIC CONVERTERS	4044
PERFORMANCE AND TESTING	4044
FUEL CELLS	4044
DESIGN AND DEVELOPMENT	4044
PERFORMANCE AND TESTING	4044
MATERIALS, COMPONENTS, AND AUXILIARIES	4044
ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS	4044

Category	Page
ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION	4044
BUILDINGS	4044
RESIDENTIAL BUILDINGS	4045
OFFICE BUILDINGS	4046
SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS	4046
COMMERCIAL AND INDUSTRIAL BUILDINGS	4046
TRANSPORTATION	4047
AIR AND AEROSPACE	4047
LAND AND ROADWAY	4047
INDUSTRY AND AGRICULTURE	4048
ENERGY SOURCES	4048
EQUIPMENT AND PROCESSES	4049
WASTE HEAT RECOVERY AND UTILIZATION	4049
INDUSTRIAL WASTE MANAGEMENT	4050
MUNICIPALITIES AND COMMUNITY SYSTEMS	4051
PUBLIC UTILITIES	4051
MUNICIPAL WASTE MANAGEMENT	4051
EDUCATION AND PUBLIC RELATIONS	4051
ADVANCED AUTOMOTIVE PROPULSION SYSTEMS	4051
INTERNAL COMBUSTION ENGINES	4051
SPARK-IGNITION	4052
DIESEL	4053
TURBINE	4053
ELECTRIC-POWERED SYSTEMS	4053
HYBRID SYSTEMS	4054
VEHICLE DESIGN FACTORS	4054
BODY AND CHASSIS	4054
ENGINE SYSTEM	4054
EMISSION CONTROL	4054
NITROGEN OXIDES	4055
ALTERNATIVE FUELS	4055
MATERIALS	4055
METALS AND ALLOYS	4055
PREPARATION AND FABRICATION	4055
STRUCTURE AND PHASE STUDIES	4056
MECHANICAL PROPERTIES	4057
PHYSICAL PROPERTIES	4062
CORROSION AND EROSION	4063
RADIATION EFFECTS	4064
CERAMICS, CERMETS, AND REFRACTORIES	4064
PREPARATION AND FABRICATION	4065
STRUCTURE AND PHASE STUDIES	4065
MECHANICAL PROPERTIES	4065
PHYSICAL PROPERTIES	4065
CORROSION AND EROSION	4065
RADIATION EFFECTS	4066
POLYMERS AND PLASTICS	4066
PREPARATION AND FABRICATION	4066
STRUCTURE AND PHASE STUDIES	4066
MECHANICAL PROPERTIES	4066
DEGRADATION AND EROSION	4066
RADIATION EFFECTS	4066
OTHER MATERIALS	4066
PREPARATION AND MANUFACTURE	4066
STRUCTURE AND PHASE STUDIES	4066
PROPERTIES	4067
CORROSION, EROSION, AND DEGRADATION	4067
RADIATION EFFECTS	4067
CHEMISTRY	4068
ANALYTICAL AND SEPARATIONS CHEMISTRY	4068
ACTIVATION AND NUCLEAR REACTION PROCEDURES	4068
CHEMICAL PROCEDURES	4069
RADIOMETRIC AND RADIOCHEMICAL PROCEDURES	4069
SPECTRAL PROCEDURES	4069
SEPARATION PROCEDURES	4069
INORGANIC AND PHYSICAL CHEMISTRY	4069
CHEMICAL AND PHYSICOCHEMICAL PROPERTIES	4069
ORGANIC CHEMISTRY	4071
CHEMICAL AND PHYSICOCHEMICAL PROPERTIES	4071
ELECTROCHEMISTRY	4072
PHOTOCHEMISTRY	4072
RADIATION CHEMISTRY	4072
RADIOCHEMISTRY AND NUCLEAR CHEMISTRY	4073
PROPERTIES OF RADIOACTIVE MATERIALS	4073
RADIOISOTOPE PRODUCTION	4073
COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY	4073
ENGINEERING	4073
FACILITIES AND EQUIPMENT	4073
CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES	4074
HANDLING EQUIPMENT AND PROCEDURES	4075
SHIPPING CONTAINERS	4075
MINING AND DRILLING EQUIPMENT AND FACILITIES	4075
LASERS	4076
HEAT TRANSFER AND FLUID FLOW	4079
MATERIALS TESTING	4080
VACUUM ENGINEERING	4080
ELECTRONIC CIRCUITS AND DEVICES	4080
COMBUSTION SYSTEMS	4081
UNDERGROUND ENGINEERING	4082
POLLUTION CONTROL EQUIPMENT	4082
POWER CYCLES	4083
BRAYTON	4083
OTHER	4083
PARTICLE ACCELERATORS	4083
DESIGN, DEVELOPMENT, AND OPERATION	4083
BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS	4084
AUXILIARIES AND COMPONENTS	4089
ION SOURCES	4089
INJECTION AND EXTRACTION SYSTEMS	4089
EXPERIMENTAL FACILITIES AND EQUIPMENT	4089
STORAGE RINGS	4093
INSTRUMENTATION	4095
RADIATION INSTRUMENTATION	4095
GENERAL DETECTORS AND MONITORS	4095
RADIATION DOSEMETERS	4095
NUCLEAR SPECTROSCOPIC INSTRUMENTATION	4096
HIGH ENERGY PHYSICS INSTRUMENTATION	4096
RADIOMETRIC INSTRUMENTS	4096
RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS	4096
MISCELLANEOUS INSTRUMENTS	4097
WELL LOGGING INSTRUMENTATION	4098
EXPLOSIONS AND EXPLOSIVES	4098
CHEMICAL	4098
NUCLEAR	4099
CIVIL USES	4099
WEAPONRY	4099
EXPLOSION DETECTION	4099
ENVIRONMENTAL SCIENCES, ATMOSPHERIC	4099
BASIC STUDIES	4100
CHEMICALS MONITORING AND TRANSPORT	4101
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	4106
THERMAL EFFLUENTS MONITORING AND TRANSPORT	4106
REGULATIONS	4107
ENVIRONMENTAL SCIENCES, TERRESTRIAL	4107

Category	Page
BASIC STUDIES	4108
CHEMICALS MONITORING AND TRANSPORT	4108
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	4108
SOIL	4109
TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS	4109
SITE RESOURCE AND USE STUDIES	4109
REGULATIONS	4109
ENVIRONMENTAL SCIENCES, AQUATIC	4109
BASIC STUDIES	4109
RADIOMETRIC TECHNIQUES	4110
CHEMICALS MONITORING AND TRANSPORT	4110
RADIOACTIVE MATERIALS MONITORING AND TRANSPORT	4111
WATER	4111
THERMAL EFFLUENTS MONITORING AND TRANSPORT	4111
SITE RESOURCE AND USE STUDIES	4112
REGULATIONS	4112
ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES	4112
SOCIAL AND ECONOMIC STUDIES	4112
ASSESSMENT OF ENERGY TECHNOLOGIES	4113
ENVIRONMENTAL IMPACT STATEMENTS	4113
BIOMEDICAL SCIENCES, BASIC STUDIES	4113
BIOCHEMISTRY	4113
CYTOLOGY	4115
GENETICS	4115
MEDICINE	4115
EXTERNAL RADIATION IN DIAGNOSTICS	4115
EXTERNAL RADIATION IN THERAPY	4115
MICROBIOLOGY	4116
PATHOLOGY	4116
PHYSIOLOGICAL SYSTEMS	4116
PUBLIC HEALTH	4116
AGRICULTURE AND FOOD TECHNOLOGY	4116
BIOMEDICAL SCIENCES, APPLIED STUDIES	4116
IN MICROORGANISMS	4116
RADIATION EFFECTS ON MICROORGANISMS	4116
BASIC STUDIES	4116
RADIATION EFFECTS ON ANIMALS	4116
MAN	4116
VERTEBRATES	4117
RADIONUCLIDE EFFECTS - INTERNAL SOURCE	4118
MAN	4118
ANIMALS	4119
NUCLIDE KINETICS AND TOXICOLOGY	4119
MAN	4119
ANIMALS	4120
PLANTS	4120
CHEMICALS METABOLISM AND TOXICITY	4120
CELLS	4120
PLANTS	4120
INVERTEBRATES	4121
VERTEBRATES	4121
MAN	4121
OTHER ENVIRONMENTAL POLLUTANT EFFECTS	4121
HEALTH AND SAFETY	4122
GEOSCIENCES	4122
GEOLOGY AND HYDROLOGY	4122
GEOPHYSICS	4122
SEISMOLOGY AND TECTONICS	4122
GEOPHYSICAL SURVEY METHODS	4123
MINERALOGY, PETROLOGY, AND ROCK MECHANICS	4124
OCEANOGRAPHY	4124

Category	Page
PHYSICS RESEARCH	4124
ASTROPHYSICS AND COSMOLOGY	4124
COSMIC RADIATION	4124
STARS	4124
QUASI-STELLAR, RADIO, AND X-RAY SOURCES	4125
SOLAR PHENOMENA	4126
GALAXIES	4127
COSMOLOGY	4127
PLANETARY PHENOMENA	4127
ATMOSPHERIC PHYSICS	4128
AURORAL AND IONOSPHERIC PHENOMENA	4128
MAGNETOSPHERIC PHENOMENA	4128
ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS	4128
BEAMS AND THEIR REACTIONS	4129
ATOMIC AND MOLECULAR PROPERTIES	4130
COLLISION PHENOMENA	4131
ATOMIC AND MOLECULAR THEORY	4132
GENERAL FLUID DYNAMICS	4132
PROPERTIES AND STRUCTURE OF FLUIDS	4133
MAGNETOHYDRODYNAMICS	4133
SUPERFLUIDITY	4133
PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL	4133
ELECTROMAGNETIC INTERACTIONS	4133
WEAK INTERACTIONS	4134
STRONG BARYON-INDUCED INTERACTIONS	4134
STRONG MESON-INDUCED INTERACTIONS	4135
PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL	4135
GENERAL	4135
ELECTROMAGNETIC INTERACTIONS	4136
WEAK INTERACTIONS	4136
STRONG INTERACTIONS, GENERAL	4137
STRONG INTERACTIONS, BARYON NO.=0	4137
STRONG INTERACTIONS, BARYON NO.=1	4137
STRONG INTERACTIONS, BARYON NO. GREATER THAN 1	4138
PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES	4138
GENERAL	4138
APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS	4138
FIELD THEORY	4138
PHYSICS RESEARCH (CONT.)	4139
NUCLEAR PHYSICS	4139
NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL	4139
NUCLEAR REACTIONS AND SCATTERING	4139
NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL	4140
ENERGY LEVELS AND TRANSITIONS	4140
NUCLEAR REACTIONS AND SCATTERING	4140
NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL	4140
ENERGY LEVELS AND TRANSITIONS	4140
NUCLEAR REACTIONS AND SCATTERING	4140
NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL	4141
ENERGY LEVELS AND TRANSITIONS	4141
NUCLEAR REACTIONS AND SCATTERING	4141
NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL	4141
ENERGY LEVELS AND TRANSITIONS	4141
NUCLEAR REACTIONS AND SCATTERING	4141
NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL	4142
ENERGY LEVELS AND TRANSITIONS	4142
NUCLEAR REACTIONS AND SCATTERING	4142
NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL	4142
ENERGY LEVELS AND TRANSITIONS	4142

Category	Page
NUCLEAR REACTIONS AND SCATTERING	4142
SPONTANEOUS AND INDUCED FISSION	4142
NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL	4142
ENERGY LEVELS AND TRANSITIONS	4142
NUCLEAR REACTIONS AND SCATTERING	4142
SPONTANEOUS AND INDUCED FISSION	4143
NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL	4143
ENERGY LEVELS AND TRANSITIONS	4143
NUCLEAR REACTIONS AND SCATTERING	4143
SPONTANEOUS AND INDUCED FISSION	4143
NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL	4143
NUCLEAR REACTIONS AND SCATTERING	4143
NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL	4143
ENERGY LEVELS AND TRANSITIONS	4143
NUCLEAR REACTIONS AND SCATTERING	4143
SPONTANEOUS AND INDUCED FISSION	4143
NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL	4143
MASS, ABUNDANCE, AND BINDING ENERGY	4143
ENERGY LEVELS AND TRANSITIONS	4143
NUCLEAR REACTIONS AND SCATTERING	4144
SPONTANEOUS AND INDUCED FISSION	4144
NUCLEAR THEORY	4144
NUCLEAR STRUCTURE	4144
NUCLEAR MATTER	4144
NUCLEAR REACTIONS AND SCATTERING	4145
SPONTANEOUS AND INDUCED FISSION	4145
RADIATION AND SHIELDING PHYSICS	4145
RADIATION PHYSICS	4145
NEUTRON INTERACTIONS WITH MATTER	4146
MEDICAL PHYSICS	4146
RADIATION SOURCE CALIBRATION AND STANDARDIZATION	4146
SOLID STATE PHYSICS	4146
SUPERCONDUCTIVITY	4147
ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA	4147
THEORETICAL PHYSICS	4147
CLASSICAL AND QUANTUM MECHANICS	4147
RELATIVITY AND GRAVITATION	4147
OPTICS	4147
STATISTICAL PHYSICS AND THERMODYNAMICS	4147
ELECTRICITY AND MAGNETISM	4147
MATHEMATICAL PHYSICS	4148
FUSION ENERGY	4148
PLASMA RESEARCH	4148
PLASMA CONFINEMENT AND HEATING	4148
PLASMA DIAGNOSTICS	4148
PLASMA KINETICS - GENERAL	4149
PLASMA KINETICS - EXPERIMENTAL	4149
PLASMA KINETICS - THEORETICAL	4149
PLASMA PRODUCTION	4149
PLASMA INSTABILITIES	4150
PLASMA WAVE PHENOMENA	4150
FUSION POWER PLANT TECHNOLOGY	4151
BLANKET ENGINEERING	4151
MAGNET COILS AND FIELDS	4151
POWER SUPPLIES, ENERGY STORAGE	4151
COOLING SYSTEMS	4152
HEATING AND FUELING SYSTEMS	4152
TRITIUM PROCESSING, ENVIRONMENT AND SAFETY	4152
INERTIAL CONFINEMENT TECHNOLOGY	4152
COMPONENT DEVELOPMENT AND MATERIALS TESTING	4152
GENERAL AND MISCELLANEOUS	4153
MANAGEMENT	4154
MATHEMATICS AND COMPUTERS	4154
INFORMATION HANDLING	4156
CORPORATE INDEX	1C
AUTHOR INDEX	25A
SUBJECT INDEX	61S
CONTRACT NUMBER INDEX	174CN
REPORT NUMBER INDEX	181R

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 38509, 38878

38042 (PB—283796) **A Kentucky Energy Resource Utilization program. Semiannual report, 1 July—31 December 1977.** (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Jun 1978. 66p. NTIS PC A04/MF A01.

This report describes progress on the Kentucky Energy Resource Utilization Program during the six-month period from July 1, to December 31, 1977. The work described is an extension and expansion of the program undertaken by the Institute for Mining and Minerals Research (IMMR) during the 1972-1974 biennium, and further expanded during the 1974-1976 biennium.

PROCESSING

38043 (COO—4748-1) **Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15—August 30, 1978.** Speicher, H.W.; Kretchman, K.W. (Industrial Health Foundation, Inc., Pittsburgh, PA (USA)). 1978. Contract EW-78-S-02-4748. 187p. Dep. NTIS, PC A09/MF A01.

This ambient air industrial hygiene evaluation was made in six selected process areas at the Pittsburgh Energy Technology Center on April 15—August 30, 1978. Personal and area sampling for predetermined dusts, vapors, gases and fumes was conducted with NIOSH approved equipment and procedures. The sample analyses were performed at the Industrial Health Foundation's AIHA accredited Analytical Laboratory. The results, reported as time-weighted average concentrations during the sampling period, indicate compliance with the present OSHA permissible values except for benzene concentrations in both laboratory areas. The present benzene TLV was exceeded on one occasion in each of the laboratory areas. These results indicate a need for periodic monitoring of both areas. Recommendations involve additional local exhaust ventilation, adjustable hood windows and periodic benzene sampling.

CARBONIZATION

REFER ALSO TO CITATION(S) 38088

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 38119

38044 (IS—4668) **Advanced development of fine coal desulfurization and recovery technology. Annual technical progress report, October 1, 1977—September 30, 1978.** Wheelock, T.D.; Greer, R.T.; Markuszewski, R.; Fisher, R.W. (Ames Lab., IA (USA)). Apr 1979. Contract W-7405-ENG-82. 84p. Dep. NTIS, PC A05/MF A01.

During the past year, progress was made in the development and improvement of several promising methods for the desulfurization and recovery of fine-size coal. The methods include froth flotation, selective oil agglomeration, pelletization, and a unique chemical desulfurization process based on leaching the fine coal with a hot dilute solution of sodium carbonate containing dissolved oxygen under pressure. The latter is a form of wet oxidation process which converts both organic and inorganic sulfur into soluble sulfates. Progress in the various methods is described.

38045 (PB—285880) **Coal desulfurization using microwave energy. Final report, August 1976—October 1977.** Zavitsanos, P.D. Bleiler, K.W.; Golden, J.A.; Kinkead, W.K. (General Electric Co. Philadelphia, PA (USA). Re-Entry and Environmental System Div.). Jun 1978. Contract EPA-68-02-2172. 79p. NTIS PC A05/MF A01.

The report describes the use of microwave energy and NaOH to remove pyritic and organic sulfur from several U.S. coals. Exposure times on the order of 1 minute at 1 atmosphere of inert gas can remove up to 85% of the sulfur with little or no loss in heating value of the coal. Data analysis suggests that sulfur is converted to water soluble sulfides (Na2S, Na2Sx) in the process and that sulfur conversion follows first-order reaction kinetics. The mechanism by which fast rates of desulfurization are accomplished is most probably related to the fast (and to some degree selective) in-depth heating of the bed. The activation of water, FeS2, and NaOH creates local volatilization, high temperature and pressure conditions which accelerate sulfur reactions before the coal has a chance to decompose. It is also quite possible that local non-equilibrium chemistry (as a result of localized discharge sites) plays a beneficial role.

GASIFICATION

REFER ALSO TO CITATION(S) 38073, 38080, 38085, 38152, 38317, 38323, 39091

38046 (ACD—38391-12) **Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, May 1—July 31, 1978.** Linhardt, H.D.; Beveridge, J.H. (Airco Cryogenics, Irvine, CA (USA)). 31 Jul 1978. Contract EF-77-C-01-2709. 25p. Dep. NTIS, PC A02/MF A01.

Progress under Contract EF-77-C-01-2709 for the period from May 1 through July 31, 1978, is summarized. Phase IA is directed toward the design, fabrication, assembly, checkout, and operation of the Ambient Analog Model. Phase II is the test program of the prototype wedge separator elements under simulated and real pressure and temperature conditions. The basic theory has been presented in Reference (1).

38047 (CONF-790405—12) **Economics of gasoline production from underground coal gasification via Mobil-M process.** Edwards, M.S.; Ulrich, W.C.; Salmon, R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

From AICE meeting; Houston, TX, USA (1 Apr 1979).

A conceptual process design and cost estimate is presented for a facility producing approximately 100 m^3/h (15,000 barrels per day) of M-gasoline via methanol from synthesis gas generated by gasification of coal in situ. The design was based on experimental data obtained at the Laramie Energy Technology Center on the linked vertical well in situ coal gasification process. In-place coal consumption is 756 Mg/h (20,000 tons/day), based on a subbituminous Wyoming coal. The capital investment was estimated to be $535 million in first quarter 1978 dollars. M-gasoline product price was calculated as a function of debt/equity ratio, annual earning rates on debt and equity, in-place coal cost, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, an interest rate on debt of 9%, an after-tax earning rate on equity of 15%, an in-place coal cost of $5.50/Mg ($5/ton), an LPG (propane) by-product credit of $3.80/GJ ($4/10^6 Btu), and a plant factor of 90%, the product price of M-gasoline (including mixed butane LPG) is about $240/$m^3$ ($0.90/gas) at the plant gate. Calculated overall thermal efficiency for the facility was 22%, based on in-place coal.

38048 (CONF-790405—14) **Department of Energy fossil energy equipment development programs.** Powell, J.L.; Williams, W.R.; Lau,

T.K.; Jones, H.T. (Department of Energy, Washington, DC (USA); Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From AICE meeting; Houston, TX, USA (1 Apr 1979).

Design, construction, and operation of synthetic fuel processing plants in the near future must consider equipment requirements to make such operations economically feasible and sound. The Department of Energy's approach is to use as much available equipment as practical, to modify and qualify equipment which is not expected to perform acceptably in its standard configuration, and to develop new equipment only if no current capability or acceptable alternative exists. Approaches, philosophy, goals, and implementation of fossil energy equipment development programs are discussed. Some results of a recent survey of industrial coal conversion equipment capabilities are presented as an example of current equipment, state-of-the-art and equipment development needs.

38049 (FE—1207-49) **Gas generator research and development: BI-GAS Process. Interim report, July 1977—June 30, 1978.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Sep 1978. Contract EX-76-C-01-1207. 254p. Dep. NTIS, PC A12/MF A01.

Work continued on the evaluation of fluidized-bed methanation catalysts at both the bench-scale and PEDU-scale levels. In addition, assistance has been given in planning, acquisition, and assessment of the BI-GAS pilot plant operation data. Bench-scale studies included six standard life tests to evaluate 22 new fluidized-bed methanation catalysts, and one life test of samples of catalyst from PEDU Test No. 27 to determine, if possible, a reason for the decreased activity of the catalyst during the PEDU test. Of the 22 new catalysts, only one showed sufficiently high activity at normal operating temperatures to justify consideration as a PEDU test candidate; a PEDU-size sample of this catalyst was ordered. A new clear-plastic model of the PEDU methanator was constructed for the purpose of studying heat-transfer characteristics within the methanator. Initial tests agreed sutstantially with PEDU data and indicated that the axial tube location gave better heat transfer than the non-axial location. A joint study with Brigham Young University on sulfur-tolerance testing of BCR fluid-bed methanation catalysts involved an evaluation of the activity of the catalysts before and after exposure to low levels of hydrogen sulfide. Five methanation PEDU tests were conducted to evaluate further the Homer City catalyst. The results are described in the report. Analytical and data processing services continued in support of the overall program. Pilot plant activity included the determination of the viscosity of samples of Ohio No. 9 seam coal ash in conjunction with the DOE-sponsored Conoco project. In addition, viscosity determinations were made on a sample of Rosebud seam coal ash with limestone added as a flux. Minor modifications were made to the viscosimeter.

38050 (FE—1207-53) **Gas Generator Research and Development: BI-GAS process. Quarterly report, July—September 1978.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Oct 1978. Contract EX-76-C-01-1207. 113p. Dep. NTIS, PC A06/MF A01.

The life test of catalyst BCR Lot No. 4108, the modified version of No. 4016, was completed. The results obtained showed that the catalyst was extremely active and thermal stability was excellent. A PEDU-size sample of the catalyst has been ordered. The life test of catalysts BCR Lots No. 4120, 4121, and 4122 was completed. These three samples are modified versions of catalyst No. 3766, previously tested, which was also included in the test. The behavior of most of these catalyst samples was rather erratic during the first 800-to-1100 F temperature cycle. Useful conversions with all the catalysts ultimately reached a constant value of 88 percent at 1100 F. The overall results show that none of the three modified versions of No. 3766 was as effective at the lower temperatures (800 F) as the prototype catalyst. The data from PEDU Test No. 30 were evaluated and the results confirmed that it is possible to operate under conditions of combined shift and methanation for extended period of time without experiencing catalyst deactivation through carbon formation. The data from PEDU Test No. 31, using the same catalyst charge as used in Test No. 30, were evaluated and again confirmed the feasibility of operating the fluidized-bed methanator at low feed hydrogen-to-carbon monoxide ratios for extended periods of time. Results to date for the Homer City methanation catalyst indicate that the bed temperature should be kept as high as possible (at least >900 F) to minimize the possibility of carbon deposition.

38051 (FE—1775-18) **Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7.** O'Hara, J.B.; Bela, A.; Jentz, N.E.; Klumpe, H.W.; Loran, B.I.; McElherne, P.F.; Teeple, R.V. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Sep 1978. Contract EX-76-C-01-1775. 178p. Dep. NTIS, PC A09/MF A01.

The MPDP design consists of the following: three principal process plants; coal receiving storage and handling facilities; and the necessary ancillaries to service the plants and a plant population of approximately 530 people. The key elements of the three plants are: plant 1 is a low pressure coal gasifier, which can be operated either in the air-blown or oxygen-blown mode, with attendant heat and sulfur recovery auxiliaries. The products generated are, initially, low-Btu fuel gas, steam, and byproduct sulfur. Plant 2 consists of two oxygen-blown intermediate pressure gasifiers, entrained and fluid-bed types with oxygen plant, heat and sulfur recovery equipment, and a combined-cycle power plant. The design provides for one of the two gasifier types to be operated at any given time. The combined-cycle power plant will provide facilities for demonstrating the performance of closely coupled generation of environmentally acceptable intermediate-Btu fuel gases from coal followed by converison to electricity in a high efficiency mode. In addition to supplying fuel gas to the combined-cycle power plant, the gasifiers will produce synthesis gas (syngas) for use in a Fischer—Tropsch indirect liquefaction plant. This syngas can later be used as feed to other indirect liquefaction facilities such as methanol, or it can be used as a source of reducing gases for tests on hydroliquefaction or donor solvent coal liquefaction plants. The informaion obtained from this syngas production unit could complement that obtained from other pilot plant and demonstration plant programs.

38052 (FE—1775-21) **Preliminary design services: research and development report No. 114. Final report.** O'Hara, J.B. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Nov 1978. Contract EX-76-C-01-1775. 134p. Dep. NTIS, PC A07/MF A01.

The prime objective of the contract was to develop conceptual designs and economic evaluations for multiple types of coal conversion plants. Secondary objectives were development of supporting information in the fields of equipment development, materials of construction and environmental factors required for future commercial plants. The contract defined a number of comprehensive task assignments. Reports have been transmitted and accepted for all task assignments under this contract. This final report provides a summary of key results and a list of references for reports which have been published; these referenced reports contain detailed designs, data, conclusions and recommendations.

38053 (FE—1784-42) **Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, April 1, 1978—June 30, 1978.** Schaefer, A.O. (ed.). (Metal Properties Council, Inc., New York (USA)). 16 Oct 1978. Contract EX-76-C-01-1784. 238p. Dep. NTIS, PC A11/MF A01.

This Quarterly Report describes in general the progress during the Second Quarter of Calendar 1978, on a program under the direction of The Metal Properties Council, Inc. designed to screen materials for use in such plants with respect to the various unique corrosive environments obtaining therein; and, finally to provide useful corrosion data as well as reliable information on other properties needed for the design, construction, and operation of such plants. The program involves high temperature corrosion studies involving low concentrations of H_2S, exposure of metal coupons and refractories in coal gasification pilot plants, aqueous corrosion erosion and corrosion testing, and measurements of the mechanical and physical properties of materials.

38054 (FE—1793-46) **Coal feeder development. Phase II report.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). Sep 1978. Contract EX-76-C-01-1793. 188p. Dep. NTIS, PC A09/MF A01.

The feeder concepts which had been selected for continued development on the basis of the Phase I program effort were translated into working hardware and tested. These feeder concepts included: a linear pocket feeder, a centrifugal feeder, a fluidized piston feeder, and a compacted coal plug feeder. Reduction of the concepts to hardware was conducted in two scaling steps. All four concepts were carried through the first scaling step (bench scale feeder development), at which time development of the plug feeder concept was suspended, and the three remaining concepts were scaled up for further testing (pilot scale feeder development). Pilot scale testing of the three remaining concepts has now been carried out and the results evaluated. The performance of the linear pocket feeder prototype met or exceeded all Phase II performance goals. Feed rates in excess of 5 tons per hour have been achieved at pressure differentials to 500 psig. The centrifugal feeder has met or exceeded all Phase II performance goals. The prototype feeder has fed pulverized coal at a rate in excess of 1-1/2 ton per hour against a 200 psig back pressure. The prototype piston feeder has fed coal at rates ranging from 250 pounds per hour at 600 psi to 110 pounds per hour at 900 psi, but additional development of the protoytpe feeder is required to achieve specified Phase II goals.

38055 (FE—2006-11) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January—March 1978.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering). Jul 1978. Contract EX-76-C-01-2006. 92p. Dep. NTIS, PC A05/MF A01.

Progress in sixteen research programs involving the gasification and liquefaction of coal, hydrogenation, catalytic cracking of coal liquids, Fischer—Tropsch synthesis and catalyst research related to all of these programs is reviewed in the report. (LTN)

38056 (FE—2229-10) **Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1—July 31, 1978.** Reucroft, P.J.; Bradley, E.B.; De Angelis, R.J.; Sargent, G.A. (Kentucky Univ., Lexington (USA)). Sep 1978. Contract EX-76-C-01-2229. 74p. Dep. NTIS, PC A04/MF A01.

Laser spectral studies of the adsorption of CO_2, O_2, H_2 and D_2 on Ni(111) are discussed in relation to graphitic adlayers and Ni surface states. No definite conclusion is made on which of these mechanisms would produce the dispersion in $\Delta\nu$ that is observed with variation in excitation frequency. It is believed that future laser spectral studies of Ni(110) and Ni(100) will help clarify the Ni(111) data. The adsorption cell which will be used during infrared reflection studies of adsorbed gases on Ni(111) is described. Criteria for its design are presented which indicate that the infrared cell should maximize spectral response while minimizing scattering losses. An upgrading of the capabilities of the ESCA spectrometer is described. The modified analyzer scanning electronics provides a significantly improved count rate especially at lower energies. A separate sample preparation chamber has been installed and given preliminary testing. Analysis of the sulfided Ni-Cr/$MgSiO_3$ catalysts has continued. A simple model of the Ni/Al_2O_3 catalyst predicts a significantly larger decrease in the Ni to Al signal than is observed experimentally. The trends are correctly predicted. The model, however, appears to oversimplify the actual catalyst structure. Auger electron spectroscopy has been used as a technique to obtain adsorption isotherms for CO on a S poisoned Ni(111) single crystal surface.

38057 (FE—2229-11) **Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, August 1, 1978—October 31, 1978.** Reucroft, P.J.; Bradley, E.B.; De Angelis, R.J.; Sargent, G.A. (Kentucky Univ., Lexington (USA)). Dec 1978. Contract EX-76-C-01-2229. 17p. Dep. NTIS, PC A02/MF A01.

A sample preparation and gas treatment system has been assembled and attached to the ESCA spectrometer. This system will allow catalysts to be reduced, gas treated, and then analyzed without being exposed to air. A sulfided Ni—Cr/$MgAl_2O_4$ catalyst has been found to be chemically similar to a similarly treated Ni—Cr/$MgSiO_3$. The SO_4/S ratio is 10% higher in the $MgAl_2O_4$ supported catalyst. The sulfur uptake is also somewhat higher in this catalyst. Raman spectra of CO adsorbed on Ni(110) and Ni(111) at -60°C show multiple CO bands in the 2020 to 2032 cm^{-1} region. The bands are assigned to linear bonded CO. Raman spectra of O_2 on Ni(111) have also been obtained with temperatures in the -130 to 0°C range. Initial runs with a Ni(111) single crystal specimen have produced preliminary LEED and AES data on a clean Ni(111) surface, sulfur poisoned Ni(111), and sulfur poisoned Ni(111) with CO adsorption. Preliminary studies on the sintering rate of a silica supported nickel catalyst (C150-1-01) in an atmosphere of hydrogen indicate that the rate is more rapid under hydrogen than under a nitrogen atmosphere. Alumina supported catalysts that are heated at 500°C for 24 hours are found to be less easily reduced subsequently, in comparison with samples that are reduced without a prior heat treatment.

38058 (FE—2369-20) **Exxon catalytic coal gasification process: predevelopment program. Annual report, July 1976—June 1977.** (Exxon Research and Engineering Co., Baytown, TX (USA)). 26 Jan 1978. Contract EX-76-C-01-2369. 104p. Dep. NTIS, PC A06/MF A01.

The Exxon Catalytic Gasification Process combines the use of alkali metal gasification catalyst with a novel processing sequence which maximizes the benefits which can be derived from use of the catalyst. The principal reasons for using alkali metal gasification catalysts are that they increase the rate of steam gasification, prevent agglomeration of caking coals, and promote the achievement of gas compositions closely approaching gas phase methanation equilibrium. The process combines a relatively low gasifier temperature of about 1300°F with separation of synthesis gas (CO + H_2) from the product methane and recycle of the synthesis gas to the gasifier. Thus the only net products from gasification are CH_4, CO_2, and small quantities of H_2S and NH_3. The resulting overall gasification reaction can be represented as follows: Coal + $H_2O \rightarrow CH_4 + CO_2$. Since this reaction is essentially thermoneutral, major heat input to the gasifier is not required. A simplified flow plan for the Exxon Catalytic Gasification Process is shown. No significant tars or oils are produced. Following heat recovery and water scrubbing, the product gas is treated in a series of separation steps including acid gas scrubbing to remove CO_2 and H_2S, and cryogenic fractionation to separate product methane from synthesis gas. The synthesis gas is combined with feed steam, preheated to approximately 150°F above the gasification temperature and recycled to the gasifier. Although there is no heat required for the gasification reactions, some small amount of heat input is required to heat up the feed coal, vaporize residual water and provide for gasifier heat losses.

38059 (FE—2496-12) **Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center.** Dunlap, R.W.; Massey, M.J. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Environmental Studies Inst.). May 1977. Contract EX-76-S-01-2496. 105p. Dep. NTIS, PC A06/MF A01.

Plans for the slagging, fixed-bed gsification pilot plant at GFERC have been altered since a previous CMU site visit. This report is to serve three purposes: CMU is to suggest objectives, strategies, and schedules for pilot plant tests involving the current reactor configuration; CMU is to suggest possible system features and operations for the revised, enlarged configuration of the pilot plant; and CMU is to suggest coordination links and activities between the ERDA coal fasification pilot plant environmental assessment program and the GFERC program. Initial CMU observations regarding each of these purposes are published here.

38060 (FE—2496-26) **Computer-aided analysis of coal gasification pilot plant data bases.** Pochan, M.J.; Massey, M.J. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Environmental Studies Inst.). Jun 1978. Contract EX-76-S-01-2496. 45p. Dep. NTIS, PC A03/MF A01.

To aid in the organization, storage, and retrieval of the large volumes of process and environmental gasification data anticipated in the DOE environmental assessment program, Carnegie-Mellon University created the Computer-aided Effluent Analysis System or CEAS. CEAS was specifically designed to: provide easy storage/retrieval of effluent data and relevant process variables; permit compilation and continual updating of comprehensive listing of these data; permit routine computations and statistical analysis of specific effluent and process parameters; and allow comparison of effluent concentration, production and distribution across runs within a given process and across a range of processes. CEAS currently exists as a package of five separate computer programs on the IBM 360 at Carnegie-Mellon University. A more detailed description of this system and its operation is available as a manual. CEAS data input formating requires that all effluent sample analyses and corresponding process data be identified by the date and time of collection, stream location and stream type. Once all data are tabulated in this manner, routine computations can be performed. CEAS displays the effluent data first as water concentrations with corresponding process information, then calculates and presents net effluent production (mass flowrate) and normalized effluent production (lb/ton of coal). Sample means and standard deviations and a sample count are also presented. The data printout format chronologically summarizes individual stream concentrations and production first, then compares all streams by run, and finally compares overall process production totals by run. The data manipulation capabilities are a powerful feature of CEAS.

38061 (FE—2621-3) **Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1—May 31, 1978.** Sadowski, E.P. (International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center). 1978. Contract EF-77-C-01-2621. 32p. Dep. NTIS, PC A03/MF A01.

Three-quarters of the welding is complete and pre-exposure testing started on one-half of the completed weldments in this program to produce overlays resistant to corrosion in coal gasification atmospheres at 982°C (1800°F). The welding processes were: submerged-arc (SAW), gas metal-arc (GMAW) and gas tungsten-arc with a hot wire addition (GTAW—HW). Pre-exposure testing was continued. The tests consisted of hardness surveys, bend, tensile, stress-rupture, bulk chemical analysis of the overlay and microprobe analysis for the distribution of major alloying elements from the outside edge of the overlay to the center of the base plate. The results are described briefly.

38062 (FE—2765-T1) **In-situ gasification of coal. Second report on the present and future programme of the U.S. Department of Energy.** Balfour, A.E. (Department of Energy, Washington, DC (USA)). Apr 1978. Contract ET-78-C-01-2765. 39p. Dep. NTIS, PC A03/MF A01.

The U.S. DOE program in in-situ coal gasification has been reviewed and analyzed by a DOE consultant from the United Kingdom. Detailed recommendations are made with respect to reconsideration and modification of certain programs, but most projects are considered acceptable, with comments mainly with respect to control of water influx (water removal by pumps is recommended for water control) and operating pressure (pressures of the order of 10 psi above atmospheric are recommended). (LTN)

38063 (FE—2806-1) **Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1—June 30, 1978.** Tran, D.Q.; Nandi, S.P.; Weil, S.A.; Knowlton, T.M.; Lee, A.L.; Anderson, G.L.; Onischak, M.; Knight, R.A.; Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1978. Contract ET-78-C-01-2806. 91p. Dep. NTIS, PC A05/MF A01.

The objective of this program is to advance coal gasification technology through a series of related studies that support the pilot plant development efforts. These studies, involving both analytical and experimental aspects at actual conditions encountered in pilot plant operations, will either generate missing basic design data or develop new processing techniques for direct application to overall process improvements and cost reductions.

38064 (LBL—8975, pp 37.-39.) **Fundamental factors in catalyzed carbon—gas reactions.** Fisher, R.M.; Szirmae, A. (US Steel Corp. Research Lab., Monroeville, PA). Feb 1979.

In Heterogeneous catalysis research meeting.

38065 (LBL—8975, pp 77.-78.) **Vibrational spectroscopic studies of coal conversion catalysts.** Brown, F.R. (Dept. of Energy, Pittsburgh, PA). Feb 1979.

In Heterogeneous catalysis research meeting.

38066 (PB—284041) **Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977.** Cooper, L. (Acurex Corp., Mountain View, CA (USA). Aerotherm Div.). Jan 1978. Contract EPA-68-02-2153. 265p. NTIS PC A12/MF A01.

The report reviews the first year's efforts under a planned 3-year program to develop measurement techniques for high-temperature, high-pressure (HTP) processes. Several related topics are discussed in detail, including: (1) the design, development, and successful demonstration of a system for sampling particulate from a pressurized fluidized-bed combustor operating at 740 C and 9 atmospheres; (2) a review of existing measurement methods to determine the best available techniques for measuring gas flow velocities, pressures, and temperatures in HTP process streams; (3) a review of various HTP coal conversion processes and recommendations for material selection for sampling them; (4) recommendations for sampling tars in a coal gasification process.

38067 (TID—28953) **Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 6, 1 July 1978—30 September 1978.** Smoot, L.D.; Hanks, R.W.; Hedman, P.O. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 15 Oct 1978. Contract EF-77-S-01-2666. 28p. Dep. NTIS, PC A03/MF A01.

This report summarizes a two-year study to investigate the mixing and gasification of coal in entrained flow systems. This is the second phase of a study initiated in November 1974. Thirty-two cold-flow tests were completed in the atmospheric test facility using 30° non-parallel secondary injection. Thirteen of these tests were with pulverized coal rather than silicon powder. The latter tests indicate a different effect of mixing chamber diameter than that found using silicon powder. This is being checked further. Design of a seondary jet swirl generator for the cold-flow-facility was also initiated. Eighteen atmospheric cold-flow tests were conducted in the high pressure gasifier to evaluate the instrument systems. It was found that longer probes are needed to allow sampling at a crucial intermediate axial position not now obtainable. Thirty-five reacting gasification tests were also completed. The prototype probe and sample train were proven operational. A full set of five probes and sample trains was constructed, installed and evaluated. Calibration of the steam flow system was initiated. The one-dimensional gasification/combustion model was applied to a Babcock and Wilcox staged combustor. Parametric studies have been conducted to evaluate the effect of gasifier operating variables and controlling rate processes in entrained flow gasifiers. The PDF formulation of diffusion-limited, gas-phase turbulent combustion has been completed and tested. The code, now functional for gaseous fuel, was applied to clean natural gas/air combustion in the BYU Rate Resolution Combustor. It has been applied to cold-flow mixing systems at BYU.

38068 (TID—29304) **Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report.** Douglass, D.L.; Vineberg, E.J.; Bhide, V.S.; Sheybany, S. (California Univ., Los Angeles (USA). Dept. of Materials). Aug 1978. Contract EY-76-S-03-0034-254. 45p. Dep. NTIS, PC A03/MF A01.

Five alloys previously studied (310 stainless, Hastelloy X, and Inconel 671, Incoloy 800, and Haynes 188) plus GE1541 (Fe—15Cr—4Al—1Y) have been exposed to FMC char (2.7%S) and 1800°F under a variety of conditions. The corrosion rates appear to follow a linear rate law or perhaps a slightly decreasing rate with time as measured by weight gains. It was found that the weight gains are erroneously high due to embedded char particles in the scale, the particles acting as Kirkendall markers during the reaction. Internal reaction in the form of sulfide particles both within the grains and at grain boundaries was extensive, in some cases completely through the samples (0.125" thick) in 96 hours. Sulfur depletion of the char results in a char-quantity effect, the greater the amount of char per sample in a given time, the greater the corrosion. Replenishment of the char at 12-hour intervals suppressed oxidation, whereas, continuous runs of 50 and 96 hours enabled oxidation of the sulfides to occur with much reduced rates compared to those measured with char replenishment. Large quantities of char (20 gms/sample) caused the formation of thick sulfide scales which were continuous to the substrate by a grain boundary network of the same sulfide. Comparison of the weight gains obtained in 96 hours for Inconel 671 when the char was replenished every twelve hours to those obtained on the IITRI/MPC program in a coal gasifier atmosphere (CGA) showed that corrosion in char was approximately 200 times more rapid than in OGA.

38069 **Processing of lignite for petrochemicals.** Halligan, J.E.; Huffman, W.J. (to Pioneer Corp.). US Patent 4,140,583. 20 Feb 1979. Filed date 5 Nov 1976. 10p.

Process and apparatus for producing ethylene from lignite and subbituminous coal by chemical condition and temperature control using cellulosic material within the treated mass or added thereto whereby ethylene gas is evolved from such carbonacous feed and recovered with other products.

38070 **Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals.** Wolff, W.F. (to Standard Oil Co.(Indiana)). US Patent 4,105,251. 8 Aug 1978. Filed date 29 Jul 1977. 10p.

Disclosed is a process for generating synthetic fuels from carbonaceous minerals such as oil shale and coal by dispersing a catalytic agent by suitable explosive means into carbonaceous deposits. The explosives serve to fracture and rubblize the carbonaceous mineral as well as conveying the catalyst onto and in close proximity to the fractured particles. The catalyst coated particles are then converted, in whole or part, to gaseous and liquid products by conventional processes such as retorting, gasification, hydroretorting, hydrogenation, or the like, wherein this process or part of it is accelerated, decelerated, or otherwise favored by the presence of the catalytic agent. This process is capable of producing an increased yield and/or better quality product since it is possible to maintain greater control over the conversion step.

LIQUEFACTION

REFER ALSO TO CITATION(S) 38048, 38051, 38052, 38055, 38065, 38066, 38069, 38085

38071 (CONF-790415—25) **Chemical structures and reactivities of coal as an organic natural product.** Collins, C.J.; Hombach, H.P.; Benjamin, B.M.; Roark, W.H.; Maxwell, B.; Raaen, V.F. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

Some chemical reactions involved in coal liquefaction have been studied using carbon 14 labelled compounds and nuclear magnetic resonance. On the basis of these studies it is concluded that the role of tetralin during coal conversion is (1) to act as a dispersion vehicle; (2) to supply hydrogen radicals, when needed, to trap coal radicals, and (3) in a very minor way to undergo intermolecular reaction with the coal through making and breaking of C—C (and possibly other) bonds. As a result of other experiments it is concluded that to the methods previously employed for breaking bonds in coal molecules and thereby lowering their molecular weights, must now be added the use of solvated-electrons for breaking -CH_2—CH_2- linkages. A possible mechanism for the cleavage of bibenzyl (used as a model compound for coal) is given. (LTN)

38072 (COO—4324-T1) **Separation of particles from coal-derived liquids via surface charge properties. Quarterly progress report, September 15, 1977—December 15, 1977.** Gidaspow, D.; Wasan, D.T.; Lee, C. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). 1977. Contract EF-77-S-02-4324. 14p. Dep. NTIS, PC A02/MF A01.

A novel device called a cross-flow electrofilter was constructed and tested with a synthetic slurry. Preliminary data indicate that it should be an alternate device for removing particles from coal derived slurries and be able to compete with pressure precoat filters and hydroclones in its ability to remove particles from liquefaction and solvent refined coal process streams.

38073 (FE—0496-T14) **Solvent refined coal (SRC) process. Research and development report No. 53. Interim report No. 23, 1976—1977. Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 11. Processing of solvent refined coal minerals.** Biswas, R. (Washington State Univ., Pullman (USA); Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS (USA)). Jan 1979. Contract EX-76-C-01-0496. 67p. Dep. NTIS, PC A04/MF A01.

The solvent refining process of Pittsburgh and Midway Coal Mining Company for coal cleaning results in a residue termed coal mineral. This residue contains essentially all the ash and inorganic

sulfur of the original coal plus some organic sulfur and undissolved carbon. The carbon content varies from 20% to 60% depending on the severity of treatment in the refining process. Coarse coal mineral from Kentucky No. 9 coal containing about 30% carbon were gasified with steam at 1150°C and 1340°C in a 4-inch batch fluidized bed reactor. Product gases consisted chiefly of hydrogen, carbon monoxide and carbon dioxide. Usually during the first 60 minutes of gasification, carbon monoxide was produced in greater quantities than carbon dioxide. Thereafter, the carbon dioxide content increased significantly. Use of coarse mineral and a high ash content in them caused quicker appearance and increased quantities of carbon dioxide during gasification. Carbon conversions exceeding 90% were achieved at 1150°C with gasification times exceeding 2 1/2 hours. The same conversion was achieved in 1 1/2 hours at 1340°C.

38074 (FE—2047-9) **Clean solid and liquid fuels from coal. Quarterly progress report, April—June 1978.** Gary, J.H.; Golden, J.O.; Bain, R.L.; Dickerhoof, D.W. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). Aug 1978. Contract EX-76-C-01-2047. 90p. Dep. NTIS, PC A05/MF A01.

Four extended continuous coal conversion experiments were completed. These experiments constituted a kinetic study to evaluate the effect of reactor residence time and temperature upon coal conversion with the unit operating in the stirred tank reactor mode. Overall conversion data are presented. In the area of inexpensive catalysts for promotion of in-situ hydrogen production and promotion of coal hydrogenation effort has been devoted to conversion modelling for SRC yield as a function of time and temperature. Various kinetic models are presented. The screening portion of the hydrodenitrogenation study investigating mass transfer effects was completed. The results were complicated by coke laydown on the catalyst. An extended experiment, approximately 100 hours in duration, was performed to obtain kinetic data for overall nitrogen removal, and for individual nitrogen compound removal kinetic data. Experimental data and preliminary kinetic modelling results are presented in this report. Work on classification of nitrogen compounds by ligand exchange and gas chromatography continued during the last quarter. A discussion of the analytical techniques, and results obtained using these techniques, are presented.

38075 (FE—2307-38) **Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). First quarter report, April 1—June 30, 1978.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1978. Contract EX-76-C-01-2307. 25p. Dep. NTIS, PC A02/MF A01.

Runs were made in the bench-scale unit to investigate hydrocarbon yields from North Dakota lignite at operating pressures of 500 and 1000 psig. The base carbon conversions were reduced to approximately 26 and 33%, and hydrocarbon liquids yields were reduced to 6.4 and 9.2 grams per 100 grams of feed carbon, respectively. These values are considerably lower than those obtained from North Dakota lignite in bench-scale unit operations at 2000 psig. At that pressure, base carbon conversions were approximately 50%, and hydrocarbon liquids yields were 18 grams per 100 grams of feed carbon. Runs were also made with Illinois No. 6 bituminous coal [free-swelling index (FSI) = 4-1/2]. To avoid plugging the reactor, the coal was mixed with fine silica sand at levels of 10%, 20%, and 30% (by weight) coal with sand. The bench-scale unit was operated using an upsweeping temperature profile at coil outlet temperatures of 1450° and 1500°F and a system outlet pressure of 2000 psig. Runs with the 10% and 20% (by weight) coal were successful. The hydrocarbon liquids yields from the bituminous coal were 17.2 grams per 100 grams of feed carbon, approximately 30% more than the average hydrocarbon liquids yield of 12.8 grams per 100 grams of feed carbon obtained from North Dakota lignite under similar processing conditions. The ramifications of increasing the operating pressure of the process development unit (PDU) to 2600 psig have been investigated, and needed changes in equipment and gas supply have been identified. Procurement and construction of the PDU will begin during the forthcoming quarter.

38076 (FE—2781-3) **Deuterium tracer method for investigating the chemistry of coal liquefaction. Quarterly technical progress report, April—June 1978.** Skowronski, R.P.; Ratto, J.J.; Heredy, L.A. (Atomics International Div., Canoga Park, CA (USA). Energy Systems Group). Jul 1978. Contract EF-77-C-01-2781. 37p. Dep. NTIS, PC A03/MF A01.

The objective of this research is to achieve a better understanding of the mechanism of coal hydrogenation. A deuterium tracer method has been developed to achieve this goal. Analysis of the spent solvent from a hydrogen donor solvent experiment gave definite insight into the mechanism occurring during donor solvent coal hydrogenation. It was found that, not only is deuterium donated from the tetralin-d_{12} to the coal, but protium is transferred from the coal to the tetralin-d_{12}—and preferentially into the α-alkyl position. NMR investigations of the products from several experiments (conducted without a donor solvent) have established that preferential deuterium incorporation occurs in all soluble fractions (oil, asphaltene, benzene—methanol soluble) in the α-alkyl positions. A comparison was made of the proton and deuteron NMR spectra of the products from the set of experiments which explored the effects of varying degrees of hydrogen contact opportunity. While it had been found that the amounts of soluble products varied among the three experiments, it was found that the structural positions of the protium and deuterium in the products do not appear to vary strongly among the experiments.

38077 (FE—2893-16) **EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966—1975), interim report.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jul 1978. Contract EF-77-A-01-2893. 54p. Dep. NTIS, PC A04/MF A01.

The Exxon Donor Solvent (EDS) coal liquefaction process is currently being developed to a state of commercial readiness by Exxon Research and Engineering Company under a jointly funded research program. Prior to this jointly funded program, Exxon carried out privately funded research over the 10 year period 1966 through 1975 which led to the selection of the EDS Process as the preferred route to produce liquid fuels from coal. This report summarizes the research program which led to the development of the EDS Process. The significant research findings and alternative processing options which were evaluated are discussed.

38078 (SAND—79-0505) **Mineral matter effects and catalyst characterization in coal liquefaction. Annual report, October 1977—September 1978.** Granoff, B.; Baca, P.M. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract AC04-76DP00789. 65p. Dep. NTIS, PC A04/MF A01.

This is the final report of a study of mineral matter effects in coal liquefaction. The objectives were to: (1) determine the general effects of mineral content on product composition for residence times of 2, 10, and 40 minutes and (2) determine the specific catalytic effects of several iron sulfides on coal conversion and product quality. To study the effects of mineral matter at relatively short residence times, we modified an existing one-liter, stirred, high-pressure autoclave for rapid heating and cooling of a coal/solvent slurry. The rapid heatup experiments were carried out with Illinois No. 6 coal in tetralin solvent, at 410°C and 1500 psig. As the residence time increased from 2 to 40 min., the conversion to benzene solubles increased from 25 to 61% and the yield of pentane-soluble oil increased from 13 to 16%. The preasphaltenes increased initially from 31 to 38%, and then decreased to 27%. Addition of pyrite (7 wt % based on coal), at a residence time of 10 min., resulted in an increase in the yield of pentane-soluble oil and a decrease in the yield of asphaltenes and preasphaltenes decreased with increasing residence time. To study the effects of iron sulfides on coal liquefaction, we carried out a series of slow-heatup runs. Naturally occurring pyrite and several different pyrrhotites were used at a concentration, based on coal, of 5.5 wt % iron.

38079 **Process for liquefying coal.** Sugimura, H.; Murakami, H.; Ohtsubo, T.; Fukuda, K. (to Mitsui Coke Co., Ltd.). US Patent 4,111,786. 5 Sep 1978. Priority date 16 Apr 1975, Japan, 10p.

Process for manufacturing reformed coal comprises the steps of (a) dispersing coal into a mixed oil which is comprised of a coal oil having a boiling point between about 150°C and 500°C and a petroleum oil having a boiling point higher than that of kerosene; (b) subjecting the coal and oil dispersion to hydrogenation conditions sufficient to depolymerize the coal; (c) separating a substantially liquified coal solution from the product of hydrogenation, and (d) distilling the liquified coal solution to recover a reformed coal. Preferably, a portion of the coal oil is recycled from the distillation stage and a portion of the hydrogen needed for hydrogenation is produced from light fractions from the distillation stage.

PYROLYSIS AND CRACKING

38080 (FE-MIT—2295T26-6) **Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1—June 30, 1978.** Bush, T.W.; Denholm, D.; Franklin, H.; Howard, J.B.; Peters, W.A.; Tejpar, Z. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1978. Contract EX-76-C-01-2295. 22p. Dep. NTIS, PC A02/MF A01.

The objective of this research is to quantitate the effects of reaction conditions on yields, compositions, and rates of production of light hydrocarbon gases, oils, liquids, tar and char formed in the pyrolysis and hydropyrolysis of coal in small scale equipment. Measurements are performed under well-defined conditions of total pressure (0.001 to 100 atm), final temperature (400 to 1100°C), particle size (25 to 1000 μm with a few runs down to 5 μm), heating rate (65 to 12,000°C/s), and reaction time (0.02 to 20 s with a resolution of 0.02 s), for two coals (a partially dried Montana lignite and a Pittsburgh Seam bituminous coal), using captive sample and entrained flow reactors. Correlations and predictive models of pyro-

lysis and hydropyrolysis are developed from the experimental data and the distributions of original sulfur and nitrogen in product chars determined.

PROPERTIES

REFER ALSO TO CITATION(S) 38063, 39211, 39212, 39240

38081 (CONF-790415—26) **Interactions of gases with coal: structural inferences.** Fuller, E.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

Microgravimetric sorption equipment and techniques have been used to elaborate the thermodynamics and kinetics described in this text. The coal, high-volatile A-bituminous Illinois No. 6, was obtained at the mine face and stored in argon prior to grinding (< 200 mesh) in argon. Sorption-desorption isotherms are given for (a) N_2 [classical vapor for surface area determinations], (b) CO_2 [often suggested as a means of determining the effective area of coal], (2) and (C) H_2O [of interest because of its inherent content in coal and its potential use as a reactant at elevated temperatures]. Classical BET analyses of the data indicate a marked disparity in the apparent specific surface area of this coal: 2.8, 128, and 68.2 m^2/gm for N_2, CO_2, and H_2O respectively.

38082 (CONF-790418—4) **SEM observations and EDX analyses of secondary mineralization in a bituminous coal.** Harris, L.A.; Cavin, O.B.; Crouse, R.S.; Yust, C.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Scanning electron microscopy conference; Washington, DC, USA (16 Apr 1979).

An investigation was made of epigenetic minerals which occur in the cleats of a high volatile bituminous coal (Ill. No. 6). The probable sequence of growth as well as growth conditions were ascertained. Detailed studies of the surfaces of these minerals with respect to their growth features and etch figures were performed by SEM. The crystallographic perfection and relative chemical purity of these minerals; namely, calcite, kaolinite, and pyrite were demonstrated by x-ray diffraction and fluorescence analyses, respectively.

38083 (COO—4227-6) **Coal anion structure and chemistry of coal alkylation. Sixth quarterly progress report, June 1—August 31, 1978.** Stock, L.L. (Chicago Univ., IL (USA)). 1978. Contract EF-77-S-02-4227. 24p. Dep. NTIS, PC A02/MF A01.

Two areas of research are discussed: one concerns progress on the alkylation of the coal polyanion using methyl iodide-C^{13} and butyl iodide-1-C^{13}; the other concerns progress on the comparison study of the reactions of tetralin-d_{12} with Illinois No. 6 coal.

38084 **Spectral method for determining impurities in anthracite and oil coke.** Perova, G.K.; Lezhneva, A.V.; Kilyachina, A.V. *Zh. Prikl. Spektrosk.;* **29**: No. 3, 549-551(Sep 1978). (In Russian).

A spectral method is described for determining impurities in anthracite and petroleum coke to replace lengthy and cumbersome chemical analysis. One spectral analysis takes 3 to 3.5 hours instead of 8 to 10 days by chemical analysis, including the procedure for obtaining ash. The method assumes the preparation of etalons of the analysed materials with different impurity contents, on the basis of which a graph is constructed with coordinates ΔS—lgC and S—lgC. The reproducibility of the two methods is estimated. Relative error of determination of Si, Fe, Al, Ti, Ca, and Mg in anthracite and petroleum coke does not exceed 10% and 20%, respectively.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 38095, 38104

38085 (EPA—600/7-78-063, pp 535-543) **Future needs and the impact on the water and waste quipment manufacturing industry due to the use of synthetic fuels.** Kominek, E.G. (Envirotech Corp., Salt Lake City, UT). Apr 1978.

From Symposium on environmental aspects of fuel conversion technology; Hollywood, FL, USA (Sep 1977).

Probably the most important needs of the water pollution control equipment industry are coal conversion wastewater characterizations which can be used more specifically for the design of chemical and/or biological waste treatment systems. These should include analyses which differentiate between organics which are readily biodegradable, slowly biodegradable, or nonbiodegradable. Treatability factors for contact media unit design would also be helpful for evaluation purposes. If laboratory facilities are available at pilot plant installations, biological treatability tests, including nitrification, should be made.Attempting to relate projected expenditures for coal conversion plants to total sales for water and waste treatment equipment is difficult. There have been predictions that equipment expenditures for water and waste treatment will be in the range between $1.5 and $2.0 billion in the 1980—1985 period.

38086 (FE—2721-2) **Utilization of coal associated minerals. Quarterly report No. 2, January—March 1978.** Buttermore, W.H. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 15 Apr 1978. Contract EF-77-S-01-2721. 10p. Dep. NTIS, PC A02/MF A01.

In order to minimize any disruption of the research effort caused by the lengthy coal miners' strike, the collection of coal samples originally scheduled was replaced with the preparation, service and performance testing of equipment to be used for sample preparation, sample characterization, structural product testing and new processes. In addition, a sample flowsheet has been designed and the necessary personnel at the designated sampling sites have been contacted to arrange for the earliest possible sampling of coal conversion and preparation facilities.

38087 (ORNL—5508, pp 92-101) **Earth Sciences.** Tamura, T.; Allen, C.P.; Arora, H.S. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: laboratory characterization of solid wastes and feed coal; laboratory leaching; field-scale leaching; air-water interface model; storm surge model; salt-dome model of geological structures along Gulf of Mexico; leachate model of coal waste pollution of ground water; chemical speciation in coal ash leachate; and channel chromatographic Kd's vs batch equilibrium Kd's. (HLW)

38088 **Adjustable device for removing pollutants from gases and vapors evolved during coke quenching operations.** Knappstein, H.; Stratmann, J.; Strobel, M. US Patent 4,145,195. 20 Mar 1979. Filed date 4 Apr 1977. 12p.

The device is positioned in a stack arranged above a location where coke quenching is performed. The coke quenching which takes place below the stack, evolves steam and gases containing solid coke particles or dust, and which must be prevented from passing into the outside atmosphere. The steam and gases flow upwardly through the stack and the device separates the solid coke particles and dust from the steam and gases. The device comprises a support beam carrying a plurality of shutter-like baffles, of plastic material, and liquid spray elements, and which is variable in length and positioned either obliquely or horizontally across the upper portion of the stack. In between successive coke quenching operations, the liquid spray elements are activated to flush the trapped solid coke particles and dust from the shutter-like baffles. The adjustable length of the device provides for the device to be positioned to extend across the stack at varying angles, or even horizontally. The device may be pivoted at either end of the stack so that it may be swung about the pivot to vary the angle of inclination of the device in the stack, and the adjustable length of the device accommodates the various oblique positions or the horizontal position. The support beam advantageously is supported by a diagonal brace extending from one wall of the stack to the support beam.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38059, 38060, 38121, 38599, 38865, 38926, 39562, 39564, 39581, 39615, 39616, 39619, 39628, 39693

38089 (ORNL—5508, pp 1-16) **Environmental Impacts Program.** Kroodsma, R.L.; Craig, R.B.; Hildebrand, S.G. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: assessment of nuclear power plants; impact assessments of uranium fuel cycle projects; fossil energy project; assessments of geothermal resource demonstration projects; enhanced oil recovery assessments; monitoring development; and fuel use environmental impact statement. (HLW)

38090 (ORNL—5508, pp 36-48) **Synthetic Fuels Program.** Gehrs, C.W.; Allen, C.P.; Anderson, R.M. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Studies on waste water derived from synthetic fuel processes included acute toxicity of coal conversion effluent components and acute toxicity of aqueous waste and wastewater components of the ORNL Bench-Scale hydrocarbonization process. The potential hazards of synthetic fuels technology development to terrestrial ecosys-

tems were studied with regard to toxicity of PAH and azaarenes. Aquatic transport studies included the following: aquatic transport of PAH and rates of PAH photolysis at the Bethlehem, Pennsylvania, coking plant site; microbial transformations of polycyclic aromatic hydrocarbons in water and sediment samples; persistence of azaarenes in aquatic systems; bioaccumulation of pathways of azaarenes; sorption of PAH to suspended particles in natural waters; and transport and fate of anthracene in pond microcosms. Studies were also conducted on environmental characterization of solid waste from a Lurgi facility. (HLW)

38091 (ORNL—5508, pp 117-135) **Terrestrial Ecology Section.** Harris, W.F.; Baes, C.F.; Blasing, T.J. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: ecological effects of air pollutants from coal combustion; gaseous diffusion plants as a source of atmospheric fluoride; atmospheric emission and plant uptake of Hg from agricultural soils near the Almaden Hg mine; Walker Branch Watershed; carbon allocation in deciduous forest trees; scaled soil hydraulic properties and water budget modeling; measured and simulated plant-water relations of yellow poplar; foliar nitrogen translocation in eastern forest species; Environmental Research Park; and forest resource management. (HLW)

38092 (PB—284297) **Source assessment: coal storage piles. Final task report May 1974-September 1975.** Blackwood, T.R.; Wachter, R.A. (Monsanto Research Corp., Dayton, OH (USA)). May 1978. Contract EPA-68-02-1874. 98p.

This report describes a study of atmospheric emissions from coal storage piles. Fugitive emissions of dust and gases are emitted from coal storage piles. The average emission factor for respirable particulate (< 7 micrometer) is 6.4 mg/kg per annum; this factor describes the emission rate 95% of the time within 108%. From the distribution of coal piles, a representative pile was selected containing 95,000 metric tons of bituminous coal. The emission rate from this pile averages 19 mg/s or 610 kg/yr. In order to evaluate the potential environmental effect of coal storage piles, a severity factor was defined as the ratio of the maximum ground level concentration of an emission to the ambient air quality standard for criteria pollutants and to a modified threshold limit value for other pollutants. Severity factors for a representative coal storage pile are 0.025 and 1.0 when the emissions are treated as gross particulate and coal dust, respectively. The national emission burden from all coal storage piles is 0.00048% of total national particulate emissions. The amount of coal stored is increasing at the rate of 3.8% per year and this will result in a 25% increase in emissions in 1978 compared to 1972. Air pollution control techniques for coal storage piles have not been generally established and no future control techniques are presently under consideration.

38093 (PB—285447) **A benefit-cost system of decision making for strip mined land reclamation in Illinois.** Beazley, R.; Rogers, C.L.; Ackerman, E. (Illinois Inst. for Environmental Quality, Chicago (USA)). Aug 1977. 308p. NTIS PC A14/MF A01.

With almost 100,000 acres to reclaim in Illinois under conditions of limited resources, the analysis required for a rational setting of priorities is lengthy and assumes a level of great significance. The problem is compounded when a number of potential end-uses and reclamation methods are to be considered along with their attendant effects upon the social and economic infrastructure of the area. To aid and assist the public decision-maker in this analysis a system has been developed utilizing the high-speed computational and data storage capabilities of the IBM-370 computer at Southern Illinois University at Carbondale. The system developed here serves the purpose of screening public strip-mine reclamation projects, identifying those projects with strong potential for high-priority under the various assumptions and conditions. The System consists of three major components: the Moeller-Beazley Model, the Reclamation Model, and the modified Illimap Model.

38094 (TID—29425(Vol.1)) **Assessment of national consequences of increased coal utilization. Executive summary.** (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Los Alamos Scientific Lab., NM (USA); Oak Ridge National Lab., TN (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. 89p. Dep. NTIS, PC A05/MF A01.

The major environmental constraints to reaching the coal-use goals of the NEP appear to be those pertaining to air quality. These constraints arise primarily because of the postulated siting of power plants and coal-burning industries in or near nonattainment areas (areas where air quality standards are currently violated) and Prevention of Significant Deterioration (PSD) Class I areas. Some additional air quality constraints may arise from siting coal-burning facilities in PSD Class II areas where allowable increments of total suspended particulates (TSP) and sulfur dioxide (SO_2) are almost exhausted. Further air quality constraints may arise from potential short-term violations of National Ambient Air Quality Standards (NAAQS) for TSP and SO_2. These constraints may affect 35% of the new utility coal use and up to 60% of the new industrial coal use projected for the NEP. Conversion of industrial boilers to coal may be inhibited in urban areas due to nonattainment provisions of the Clean Air Act Amendments (CAAA) which do not allow further deterioration in areas that already do not meet regulations, even if emissions are controlled by New Source Performance Standards (NSPS) that are more stringent than present State Implementation Plan (SIP) controls. Other constraints discussed are: Long range sulfur transport as dioxide and sulfates, health effects of air pollution, water quality and availability, solid waste disposal, socio-economic effects,economics (capital and labor investment required), occupational health and safety (accidents in mining and transporting coal), etc.

38095 (TID—29425(Vol.2)) **Assessment of national consequences of increased coal utilization. Executive summary.** (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Los Alamos Scientific Lab., NM (USA); Oak Ridge National Lab., TN (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. 346p. Dep. NTIS, PC A15/MF A01.

This report is a summation of the efforts of personnel at six national laboratories and in the U.S. Department of Energy. In addressing the set of National Energy Plan (NEP) scenario assumptions, ten technical areas were considered: Siting, Air Quality, Western Long-Range Transport of Sulfur, Eastern Long-Range Transport of Sulfur, Water Quality, Water Availability, Solid Waste, Local Socioeconomics, National Economics, and Health Effects. The major constraints to reaching NEP coal use goals, which are 160 GWe of new utility coal use and 4.5 Quads of new industrial coal use, appear to be those pertaining to air quality. They involve the siting of utility and industrial sources in or near nonattainment areas or Prevention of Significant Deterioration (PSD) Class I areas. Siting constrants can be expected as well in PSD Class II areas where allowable TSP and/or SO_2 increments are almost exhausted. Further restrictions would be caused by potential short-term SO_2 and TSP National Ambient Air Quality Standards (NAAQS) violations. Thirty-five percent of new utility coal use may be affected by these constraints. Up to 60% of new industrial coal use is potentially restricted due to these regulations. Implementation of NEP initiatives should not cause increased public health impacts. Water quality and water availability constraints on site-specific bases are expected. Solid waste does not appear to be a constraint for achieving NEP coal use goals. Neither national economic nor regional socioeconomic impacts appear to cause major restrictions to reaching NEP goals. Yet, there may be major socioeconomic impacts on a local basis where large-scale energy facilities will be located in areas of low assimilative capacity. Uncertainties surrounding the regulatory framework may significantly affect impact analyses and should be taken into consideration.

MINING

REFER ALSO TO CITATION(S) 38132

38096 **Development trends in remote control systems used in Soviet mining.** Brzozka, E.; Rej, A. *Mech. Autom. Gorn.;* **25**: No. 9, 10-15(Sep 1977). (In Polish).

The present position and development trends in remote control in Soviet mining are described. Block diagrams of some present systems are given.

38097 (N—78-28586) **A life-cycle description of underground coal mining. Interim technical report.** Lavin, M.L.; Borden, C.S.; Duda, J.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Jul 1978. Contracts NAS7-100;ET-76-I-01-9036. 102p. NTIS PC A06/MF A01.

An initial effort to relate the major technological and economic variables which impact conventional underground coal mining systems, in order to help identify promising areas for advanced mining technology is described. The point of departure is a series of investment analyses published by the United States Bureau of Mines, which provide both the analytical framework and guidance on a choice of variables.

38098 (N—78-30636) **A closed network queue model of underground coal mining production, failure, and repair.** Lohman, G.M. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Aug 1978. Contract NAS7-100. 52p. NTIS PC A04/MF A01.

Underground coal mining system production, failures, and repair cycles were mathematically modeled as a closed network of two queues in series. The model was designed to better understand the technological constraints on availability of current underground mining systems, and to develop guidelines for estimating the avail-

ability of advanced mining systems and their associated needs for spares as well as production and maintenance personnel. It was found that: mine performance is theoretically limited by the maintainability ratio, significant gains in availability appear possible by means of small improvements in the time between failures the number of crews and sections should be properly balanced for any given maintainability ratio, and main haulage systems closest to the mine mouth require the most attention to reliability.

38099 (PB—284016) **Roof bolting hazard analysis study. Final report, 1 July 1976—30 June 1977.** Adkins, J.H.; Hargreaves, W.J. (Bendix Corp., Englewood, CO (USA). Energy, Environment, and Technology Office). Jul 1977. Contract J0265014. 134p. NTIS PC A07/MF A01.

The purpose of this research is to identify hazards associated with roof bolting and to make recommendations for procedural and equipment design changes to reduce those hazards. To that end, the project reviewed literature on related research, collected and analyzed roof bolting injury data, normalized the injury data by exposure time to each activity, and identified problem areas within the roof bolting tasks. In addition, field data collection forms were prepared and mines selected for field work. The study produced over 50 specific recommendations involving machine design, procedural safety training, and supervisional issues that would lead to reduced roof bolter injuries in the near term.

38100 (PB—284196) **Mine machinery trainer, development and fabrication.** Seidle, N. (Doron Precision Systems, Inc., Binghamton, NY (USA)). 10 Dec 1976. Contract H0242037. 102p. NTIS PC A06/MF A01.

This report describes the development of a mine machinery training system from initial conception through a task and skill analysis, a training system analysis, implementation of a prototype system, and initial validation of the prototype system. The objectives of the training are to improve safety and productivity simultaneously by complete, thorough training. A task and skill analysis was executed for shuttle cars, continuous miners, cutters, loaders, face drills, tractors, and scoops. The prototype training system is for shuttle care operator training.

38101 (PB—285041) **Design, fabrication and field testing of remotely operated longwall head/tail supports. Final report.** Bellows, A.; Curcio, J. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jun 1977. Contract H0252020. 97p. NTIS PC A05/MF A01.

The objective of this contract is to design, build, and demonstrate a support system to improve roof control in the entries of longwall mines. The objective of this phase has been the detailed design of such a system and the selection of a test site in which to perform the pilot demonstration. The result is a complete set of detail drawings or specifications which define the three major components of the system. The gate support is a variation of a face chock which has an extended canopy and additional hydraulic legs to protect the region of the face-entry intersection. The entry support is a steel beam and hydraulic prop set which is reusable and serves to support the first 100 or more feet of entry in by the longwall face. The transporter is a bolter-like vehicle with a crane used for installing and retreating the beam sets.

38102 (PB—285096) **Dynamic particle size measurement of coal dust. Final report, 1 October 1973—30 November 1976.** Marple, V.A.; Rubow, K. (Minnesota Univ., Minneapolis (USA). Particle Technology Lab.). Feb 1977. Contract H0133095. 155p. NTIS PC A08/MF A01.

The report evaluates methods and techniques by which the size distribution and concentration of mining-related dusts can be measured. One result has been the development of a portable, battery-operated optical particle counter multichannel analyzer system which can be used to determine the size distribution and concentration of mining aerosols. One important aspect has been the development of a calibration technique which relates the output of the optical particle counter to the penetration of the particles through an impactor. This results in a calibration curve in terms of the aerodynamic ofr Stokes' diameter of the aerosol particles. Using this technique, calibrations were performed on coal, silica, Arizona road dust, potash, and rock dust (copper ore) aerosols. Another task described is the calibration and evaluation of the GCA respirable dust monitors (RMD) 101-1 and 301. Other tasks discussed include performing field studies in cooperative research programs with Bureau of Mines personnel, development of a portable polystyrene latex generator for use in optical particle counter calibrations in the field, the incorporation of impactor classification devices on to the inlets of aerosol mass measuring instruments to give mass size distributions, and a study of the density of coal particles as a function of the particle size.

38103 (PB—285122) **Testing program for mining coal in an oxygen free atmosphere. Volume 1. Final report.** Taliaferro, R.C.; Motz, D. (Island Creek Coal Co., Holden, WV (USA); NUS Corp., Pittsburgh, PA (USA). Cyrus William Rice Div.). May 1978. 102p. NTIS PC A06/MF A01.

A systems evaluation was undertaken to demonstrate the ability of miners wearing life support systems to operate conventional mining equipment and to mine coal at a test section in an active ventilated mine. Their ability to operate mining equipment and to perform other in-mine tasks was successfully demonstrated. No major difficulties were encountered in performing these tasks and the miners reported they had never been that comfortable before when working in a mine. The life support system provided cool, clean air for the miner and did not hamper his ability to work. The system was adequate to demonstrate the miner's ability to mine coal while wearing a life support system. However, mechanical failures in the chiller and rebreather module were experienced. Additional work to develop a totally reliable life support system and further testing under ventilated conditions are required before testing in an oxygen free atmosphere.

38104 (PB—286988) **A fire retardant froth foam seal topping system for the USBM remote mine sealing system. volume I. Final report Jun 75-Aug 77.** Wallhagen, R.E.; Douglas, S.B.; Monaghan, D.A. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Dec 1977. Contract H0155061. 79p. NTIS PC A05/MF A01.

The froth foam seal topping system is part of a system for remote sealing of mine passages using fly ash transported pnuematically from the surface. Making the final 5 percent of the seal with a foamed-in-place fire retardant polyurethane reduces the required flyash volume by 50 percent and provides a more reliable seal. Foam components are held at the surface under proper conditions of temperature and pressure; then conveyed down the borehole through individual hoses, and mixed at the bottom with a static mixer. The polyol component is premixed with fluorocarbon-12 which, when released from system pressure in the mixer, boils and causes the foam to expand. Difficulties in handling this particular foam formulation are offset by a flame spread index well below the 25 level by ASTM E-162 normally required for underground applications. Isocyanate, polyol (TDI), and catalyst are conveyed to the downhole package by three separate lines. Five additional lines operate the valving and convey solvent so that the mixer and package lines can be flushed immediately after foaming. The eight-hose bundle is provided in segments of several lengths so that borehole depths can be matched. Cast-in-place plastic cylinders hold the bundle together and transfer the weight of the hose through a special quick-release clamp to the crane's wire rope. The downhole package and hose bundle are deployed using a specially designed winch and crane system capable of borehole deployment to 1,500 feet.

38105 **Control of self-advancing mine roof supports.** Ward, R.; Darbyshire, K. (to Dobson Park Industries Ltd.). US Patent 4,146,271. 27 Mar 1979. Priority date 20 Aug 1976, United Kingdom of Great Britain and Northern Ireland (UK), 20p.

Control units at each support have means for receiving function initiating signals from a communication system common to the supports, means responsive to those function initiating signals for issuing corresponding control signals to component elements of the associated support and means for transmitting data to the communication systems. A remote control unit has means for issuing control signals including such function initiating signals over the communication system, means for receiving data from the supports, means for specifying a sequential or automatic mode wherein support advancing means are successively operated sequentially, and means for displaying data from and relating to the supports. Advantageously, the sequential or automatic mode specifying means is operative relative to a preset distance, and the remote control unit further comprises means for specifying selective or manual modes wherein an individual support is selected and controlled without reference to any set sequence, one such selective or manual mode implementing the operation of the support advancing means to a, or said preset distance, and another allowing such operation without preset of its distance.

38106 **Mine roof support method and apparatus.** Kelley, J.H. US Patent 4,146,349. 27 Mar 1979. Filed date 26 Apr 1978. 6p.

A support for a mine opening includes an elastic plate member with a preformed curvature across its length. Two props at each end of the plate member provide support after emplacement into a load-bearing contact with the roof stratum in a flattened or near flattened configuration to exert substantially uniform pressure against the roof stratum. Rectangular tubes form chock blocks connected to the ends of the plate member. Each chock block includes a clevis to retain the ends of the two props. A spacer maintains a small clearance between the roof and the terminal end portions of the plate member and an anchor pin connects each chock block to the plate member.

38107 Hydraulic mine prop. Koppers, M.; Dombrowski, O. (to Thyssen Industrie AG). US Patent 4,142,449. 6 Mar 1979. Priority date 3 Feb 1976, German, Federal Republic of (F.R. Germany), 4p.

A hydraulic mine prop comprises a cylindrical top ram portion and a bottom ram portion which is telescopically engageable in said top ram portion and has an upper piston portion in sliding sealing engagement with the interior of said top ram portion. A ram head closes the top of said ram portion and a valve seat body is disposed between the ram head at a spaced location therefrom adjacent the top of the top ram portion and defines a vent space therebetween. The valve seat body also encloses a pressure space between itself and the piston and a passage is defined through the valve body within a valve seat portion thereof which communicates the pressure space to the vent space. The passage is closed by a spring-biased valve which may open against the biasing force of the spring. The construction includes one or more passages extending through the valve seat and through various generally radially extending passages defined in the body from the pressure space to the vent space and additional passages which are defined outwardly from the vent space to the atmosphere. The construction also includes a ring around the top ram portion having an annular passage which is communicatable through a port or bore of the top ram portion cylinder to a pressure holding valve space which is closable by a rotatable globe valve.

38108 Mining machine. Greenhough, P. (to Dresser Europe S.A.). US Patent 4,140,951. 20 Feb 1979. Priority date 23 Sep 1976, United Kingdom of Great Britain and Northern Ireland (UK), 6p.

A mining machine includes drive unit means for driving a haulage winch and a cutting tool of the machine, the drive unit means comprising a multi-phase induction motor with a wound rotor. In order to control the motor speed, the motor is provided with a circuit connected across the rotor windings and means for varying the effective impedance presented by the said circuit to the rotor windings.

38109 Present state and directions of progress in mechanization of development work. Maloszewski, J.; Iwan, A. *Mech. Autom. Gorn.;* **25**: No. 10, 8-14(Oct 1977). (In Polish).

The importance of using a combined cutter loader to drive headings, and the need for and suitability of other means of driving rising headings and crosscuts in rock are pointed out.

TRANSPORT AND HANDLING

38110 (DOE/TIC—10053(Vol.1)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 1. Summary and conclusions. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 91p. Dep. NTIS, PC A05/MF A01.

This study, an extension of our previous work in the area of coal transportation, is the comparative costing of competing transport modes. A wide range of costs and aspects of costs are dealt with in terms of engineering - economic analyses of the cost of the components which make up the facility and operating system descriptions of each coal transport mode. The project is divided into two main sections: (1) long distance coal transport; and (2) gathering and distribution systems. Within each section, economic and technological comparisons of the available modes are used as the basis for comparisons among the modes. Inter-modal compatibility is studied with respect to both mixed trunk line shipment and with respect to feeder to trunk line and trunk line to distribution systems. The engineering and technological data form the bases for the costing and economic analyses. The cost basis includes all necessary processing, loading and unloading facilities needed for transport by each mode. Emphasis is placed on cost optimality and the ability to increase capacity. Specific studies are made of unit trains, barge, and coal slurry pipelines. The advantages and limitations of each system are analyzed.

38111 (DOE/TIC—10053(Vol.2)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 2. Unit trains. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 112p. Dep. NTIS, MF A01.

Portions of document are illegible.

A unit train is a single purpose, dedicated, integrated train used for hauling a single commodity; coal in this study. It is composed of special purpose cars which haul continuously between a mine and the consumer. Advantages accrue to both the railroad and its customers. In fact, the advantages are sufficiently obvious for some customers (utilities) to own their own unit trains. For the coal burning utilities, they lower fuel expenditures and help to establish a stable fuel supply thereby reducing the level of inventories which must be held. The mining company benefits from increased efficiency in movement resulting in lower transport costs, a higher netback at the mine and the ability to make stable long-term contracts. These trains may move over 800 miles/day instead of the 60 miles/day associated with general freight schedules. This improvement could be reflected in lower rates which might increase coal usage through lower total prices for coal at the point of consumption. For the railroads, unit trains provide better utilization of equipment and plant than do other rail modes. Unit trains have been treated in detail in several previous studies. Among the important factors to note are: (1) they generate less revenue/ton shipped than general freight; (2) their cost is higher in stop and go situations than regular freight because unit trains carry more weight; (3) their costs are influenced by grades; and (4) the principal benefit of the system comes from the greater utilization of railway capacity. The basic costing procedures, facility descriptors and other parameters used in this study are based on recent work done at the University of Illinois.

38112 (DOE/TIC—10053(Vol.3)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 3. Coal slurry pipelines. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 57p. Dep. NTIS, PC A04/MF A01.

A coal slurry pipeline system requires that the coal go through a number of processing stages before it is used by the power plant. Once mined, the coal is delivered to a preparation plant where it is pulverized to sizes between 18 and 325 mesh and then suspended in about an equal weight of water. This 50-50 slurry mixture has a consistency approximating toothpaste. It is pushed through the pipeline via electric pumping stations 70 to 100 miles apart. Flow velocity through the line must be maintained within a narrow range. For example, if a 3.5 mph design is used at 5 mph, the system must be able to withstand double the horsepower, peak pressure, and wear. Minimum flowrate must be maintained to avoid particle settling and plugging. However, in general, once a pipeline system has been designed, because of economic considerations on the one hand and design limits on the other, flowrate is rather inflexible. Pipelines that have a slowly moving throughput and a water carrier may be subject to freezing in northern areas during periods of severe cold. One of the problems associated with slurry pipeline analyses is the lack of operating experience.

38113 (DOE/TIC—10053(Vol.4)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 4. Barge transport. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 93p. Dep. NTIS, PC A05/MF A01.

Commodity transportation by barge is possible on about 25,000 miles of navigable inland waterways in the contiguous 48 states. Barge operations are used chiefly for the movement of bulk raw materials ranging from farm products to iron ore, coal, and other bulky semi-finished as well as finished products such as steel, chemicals and petroleum. The barge industry, unlike other transportation industries, is largely unregulated.. This is because all liquid bulk commodities, most dry bulk commodities transported by for-hire carriers and by companies engaged in private transportation of their own commodities are exempted from Interstate Commerce Commission regulations. The approximately 1700 companies engaged in commercial barge operations use a total of about 4100 towboats and tugs with a combined horsepower of 5,088,221; 21,876 dry cargo barges with a total cargo capacity of 25,525,896 net tons and 3,534 tank barges with a cargo capacity of 8,201,561 net tons. Even though the railroads have carried the major portion of the coal produced in ths country, the inland waterways have borne a substantial percentage of the total. In 1974, domestic barges carried 122,581,992 net tons of coal. The location of the major river systems may make waterways a significant means by which to more the projected increases in coal production from central Appalachia and the northern Great Plains to the Midwest. In this study we examine the cost and capacity parameters of those waterways that affect the movement of coal.

38114 (DOE/TIC—10053(Vol.5)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 5. Conveyor belts. Final report.** Reiber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 61p. Dep. NTIS, PC A04/MF A01.

A generalized specification and costing model for high tonnage coal carrying conveyor belts of 3.5 to 100 miles is presented. These belt systems, in modular units or flights, of up to 9 miles in length can be considered in terms of gathering systems. This study has concentrated on setting up an heuristic programming model for conveyor belt facility optimization and cost minimization. The analysis starts with the principle factors involved in the design of the system and their optimization for various cases. This is followed

with a factor by factor cost analysis based on industry data and the preceding optimization. Finally, it has been assumed that the belt movement is over level terrain; if the terrain is hilly, both construction and operating costs increase. Operating costs rise due to increased belt tension. The program can be used, as needed, to provide the operating costs for any feasible terrain. A conveyor system is versatile and easy to operate. It is generally reliable and, once installed, has low maintenance and operating costs. As tonnages increase, fixed and operating costs become even more favorable. Nylon had been considered suitable only for the cross and filler threads of the belt carcass. Technical advancement in heat setting and fabric weave created a major change by allowing full tension strength. Nylon resists moisture, acid and mildew. It also has excellent resistance to impact and can be produced with controlled elongation and elastic properties that work to advantage in reduced-ply belt construction. Another technical breakthrough produced a significant increase in chemical bond adhesion. The improved interface between an underground hauling system and a surface hauling system has been an important cost reducing factor in coal mining.

38115 (DOE/TIC—10053(Vol.6)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 6. Truck haulage. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 63p. Dep. NTIS, PC A04/MF A01.

Among the principal gathering/distribution systems for coal is over-the-road trucking. Also where alternative trunk line modes such as barge or rail links are weak or nonexistent, trucks may, particularly for relatively short line hauls, act as substitutes. Their major application, however, appears to be in connection with smaller mines or coal users particularly where terrain problems are significant. Truck use has increased as rail lines have been abandoned or suffered neglect. Increased emphasis on road building, particularly during the 1950's and 1960's, and improved truck load capacity and efficiency were also important. Coal haulage costs by truck are relatively high. Other things being equal, variations in these costs are largely a function of road conditions, terrain and weather. In this study estimates are made of capital and operating costs of truck haulage. These include a separable estimate of road use costs. A computer model is presented which will enable users to generate their own cost data tailored to their specific needs. Because of the size of the trucks, industry trends, and the increasing cost of gasoline and, possibly, associated taxes, the cost calculations have been made in terms of diesel fuel rather than gasoline. The analysis excludes all taxes. Fuel taxes differ by state while property taxes differ by state and locality. Both also depend on the size of the operation which is determined only after an optimization calculation. Users may wish to add taxes as a lump, or distributed, sum after completing the costing model.

38116 (DOE/TIC—10053(Vol.7)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 7. Pneumatic transport. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 77p. Dep. NTIS, PC A05/MF A01.

Pneumatic transport is not a novel concept and commercial experience with pneumatic pipelines for short haul distances is plentiful. The list of applications is long and includes transporting ores, chemicals and pharmaceutical products, agricultural products, and domestic and industrial wastes. The most recent economic evaluation of pneumatic transportation of coal concluded that there are immediate advantages for short-distance transport (less than 100 miles) and that it is both technologically and economically feasible. That study also concludes that pneumatic transport has a higher potential and more promising profitability in long-distance applications than rail if new track and roadbed must be built. Some of the advantages of long and short distance pneumatic pipeline transport of coal compared to rail and slurry transport are given.

38117 (DOE/TIC—10053(Vol.8)) **Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 8. Yellow ball rail. Final report.** Rieber, M.; Soo, S.L. (Illinois Univ., Urbana (USA). Center for Advanced Computation). Aug 1977. 13p. Dep. NTIS, PC A02/MF A01.

Rail cars are referred to as yellow-balled when they are sufficiently old or damaged to preclude their efficient operation on long-haul or main line routes. For most coal carrying railroads, their alternative value is salvage. This, however, does not necessarily preclude their effective use, on a limited basis, by small mines located near existing trackage. Because of age, the sizes of these hopper and gondola cars are currently 50 and 70 tons rather than the 100 tons commonly built at the present time. As a gathering system, yellow-ball rail could provide an alternative, particularly in Kentucky, western Pennsylvania and West Virginia, to coal trucks, conveyor belts and pneumatic pipelines. Rail service of this type provides a limited alternative to track abandonment, a possible financial return to a railbank, a direct contribution to service demand on main lines, and a means by which many small eastern coal mines could retain or regain competitive viability. In terms of energy efficiency, compared to trucking coal, the total direct energy impact (fuel) of yellow-ball rail can be expected to range from 280 to 990 Btu/ton-mile while that for trucks ranges from 1850 to 3120 Btu/ton-mile. It is primarily as a gathering, rather than a distribution system, that yellow-ball coal transport has an impact.

38118 (FE—2722-3) **Effects of minerals on coal beneficiation processes. Quarterly report No. 3, April 1—June 30, 1978.** Buttermore, W.; McMillan, B.G.; Slonaker, J.F. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 15 Sep 1978. Contract EF-77-S-01-2722. 19p. Dep. NTIS, PC A02/MF A01.

Samples of coal feed, clean coal and refuse from the first of three preparation plants to be sampled for this contract were obtained during this quarter. Arrangements to sample another plant have been finalized. Sample preparation, storage in inert atmosphere, and characterization work has been performed and some preliminary data is included for the Loveridge plant samples. Laboratory scale beneficiation equipment has been test run at the beneficiation pilot plant.

38119 (FE—9005-T1) **Recovering fine-size coal from Alabama underground mine washer wastes using the Humphreys spiral.** Browning, J.S. (Alabama Univ., University (USA). Mineral Resources Inst.). 1978. Contract ET-76-G-01-9005. 14p. Dep. NTIS, PC A02/MF A01.

The Mineral Resources Institute and State Mine Experiment Station of The University of Alabama conducted Humphreys spiral tests of fine coal waste from nine preparation plants of Alabama underground mining operations, to determine the feasibility of recovering low ash and sulfur fuel meeting steam coal specifications. The ash in the samples ranged from 19.0 to 41.9 percent, and the total sulfur ranged from 0.68 to 1.33 percent. Continuous laboratory tests using a Humphreys spiral gave good recovery of the coal with excellent rejection of the ash and pyritic sulfur. Coal recoveries of 95.6 to 97.5 percent were achieved from the different samples. Ash content of the clean coal products fell within a range of 8.1 to 8.7 percent, with a total sulfur content of 0.81 to 1.29 percent. In quality, the products were comparable or superior to those now being shipped from the preparation plants.

38120 (PB—285251) **An engineering/economic analysis of coal preparation plant operation and cost. Final report.** Holt, E.C. Jr. (Hoffman-Muntner Corp., Silver Spring, MD (USA)). Jul 1978. Contract DOE-ET-75-C-01-9025. 314p. NTIS PC A14/MF A01.

This report presents a discussion of the major physical coal preparation processes currently available and the equipment used by each to effect a separation of the coal from the undesirable constituents such as ash and pyritic sulfur. Further, eight specific examples of a wide range of actual preparation plants are examined from the standpoint of capital and operating and maintenance costs to develop a total cost of coal cleaning for each plant. The preparation plants examined were all operating as of mid-1977 and span a spectrum of cleaning processes from a relatively simple jig plant to rather sophisticated circuits utilizing heavy media, froth flotation, and thermal drying.

38121 (SAI—068-79-516) **Water pollution control for coal slurry pipelines. Final report.** Anderson, O.L.; Rogozen, M.B.; Margler, L.W.; Mankiewicz, P.; Axelrod, M.H. (California Univ., Los Angeles (USA). Inst. of Geophysics; Science Applications, Inc., Los Angeles, CA (USA)). 30 Jun 1978. Contract EY-76-S-03-0034. 226p. Dep. NTIS, PC A11/MF A01.

Our experiments with artificial slurries of Utah bituminous coal and water confirmed other researchers' findings that inorganic salts leach from finely-divided coal into water under anaerobic conditions. We also determined that a variety of aliphatic and aromatic hydrocarbons enter the water. Unless very low quality water (e.g. brackish water or raw sewage effluent) is used as the carrier medium, substances in the leachate pose no special problem for re-use of the water in power plant cooling systems. If recovered slurry water is discharged to navigable waters, then state and federal regulations may require additional removal of suspended solids and organics. Technology for removing fine coal particles is available and more thorough clarification of recovered slurry water, through improved system design, is to be expected. Activated carbon or polymeric adsorption appear to be the best available techniques for control of the organic substances likely to be leached from the coal. High total dissolved solids and high sodium absorption ratios could pose serious problems were the recovered slurry water to be used directly for agriculture. Dilution with fresher water or treatment by ion exchange or reverse osmosis could reduce these parameters, although the cost (on the order of $100 per acre-foot) may be prohibitive for many agricultural users. Finally, our experiments showed thatcontact with coal would not significantly upgrade the

quality of primary sewage effluent although, in this particular case, bacterial virus removal and virtually complete. Treatment of this effluent for re-use in a power plant would add about 5 to 8 cents per ton to coal transportation and dewatering costs.

38122 **Coal cutter vehicle.** Booth, W.G.; Pole, C.D. (to Timberland Equipment Ltd.). US Patent 4,140,229. 20 Feb 1979. Priority date 1 Mar 1977, Canada, 16p.

A reclaimer apparatus is positioned in an elongated bulk material containing hopper or cargo hold of the type having opposed side walls which slope downwardly and inwardly toward the hopper bottom, the latter having a series of longitudinally extending discharge openings therein for discharging the bulk material on to a conveyor running lengthwise of the hopper. The reclaimer apparatus includes a rigid frame adapted to be located above the discharge openings and means for propelling the frame along the hopper bottom. The reclaimer has cutters thereon adapted to cut through bulk material, such as coal, in planes lying generally parallel to and adjacent the sloping side walls whereby to undercut the bulk material and to cause same to cascade downwardly and along the side walls and through the discharge openings.

COMBUSTION

38123 (FE—2489-27) **Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 2, Kiln Burner.** Waibel, R.T.; Fleming, E.S. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1978. Contract EX-76-C-01-2489. 45p. Dep. NTIS, PC A03/MF A01.

Data were gathered to determine the performance of a kiln burner when retrofit with three low-Btu gases. The burner was fired on the IGT pilot-scale test furnaces with a load simulating the calcining and reaction zones of a cement kiln. The low- and medium-Btu gases simulated for these combustion trials were Koppers-Totzek oxygen, Wellman-Galusha air, and Winkler air fuel gases. Koppers-Totzek oxygen fuel gas was an excellent substitute fuel, exhibiting equal or better performance than natural gas. Wellman-Galusha air and Winkler air fuel gas both exhibited flame stability problems on the unmodified burner. These two fuels also gave lower thermal efficiencies than natural gas and Koppers-Totzek oxygen fuel gas when fired on a modified fuel injector.

38124 (HCP/T2461—10) **Industrial application of fluidized-bed combustion. Quarterly technical progress report, October—December 1978.** (Georgetown Univ., Washington, DC (USA)). Apr 1979. Contract EX-76-C-01-2461. 15p. Dep. NTIS, PC A02/MF A01.

In line with a determination by the Federal Government that a fluidized bed combustion process can efficiently convert the energy of coal to usable power in an environmentally acceptable manner, Georgetown University was awarded Letter Contract E(49-18)2461 by the then Energy Research and Development Administration (now Department of Energy-DOE) to construct and operate a demonstration plant. The Letter Contract was replaced by Contract EX-76-C-01-2461 on April 27, 1977. This, the eighth quarterly progress report under the contract, reflects significant progress made on plant construction, boiler fabrication and erection, receipt and installation of prepurchased equipment, shop drawing review and approval, and facility redesign to meet requirements of equipment shop drawings.

38125 (M—78-68(Vol.1)) **Proceedings of the fifth international conference on fluidized bed combustion. Volume 1: overview.** Bliss, C.; Williams, B.M. (eds.). (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1978. Contract EX-76-C-01-2453. 202p. (CONF-771272—P1). Dep. NTIS, PC A10/MF A01.

From 5. international conference on fluidized bed combustion; Washington, DC, USA (12 Dec 1977).

This volume contains the keynote address (by S. David Freeman, TVA) and general overview talks on fluidized-bed combustion programs in: US DOE, U.K., U.K. NCB (IEA services), German Federal Republic, US EPA, Ohio, New York State, TVA, EPRI and American Electric Power Service Corp. (LTN)

38126 (N—78-28225) **Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor.** Zellars, G.R.; Rowe, A.P.; Lowell, C.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1978. 33p. NTIS PC A03/MF A01.

Four candidate turbine airfoil superalloys were exposed to the effluent of a pressurized fluidized bed with a solids loading of 2 to 4 g/scm for up to 100 hours at two gas velocities, 150 and 270 m/sec, and two temperatures, 730 deg and 795 C. Under these conditions, both erosion and corrosion occurred. The damaged specimens were examined by cross-section measurements, scanning electron and light microscopy, and X-ray analysis to evaluate the effects of temperature, velocity, particle loading, and alloy material. Results indicate that for a given solids loading the extent of erosion is primarily dependent on gas velocity. Corrosion occurred only at the higher temperature. There was little difference in the erosion/corrosion damage to the four alloys tested under these severe conditions.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 38095

38127 (DOE/TIC—10089) **Short term coal demand model. Final report.** (Young (Arthur) and Co., Washington, DC (USA)). 22 Apr 1977. 42p. Dep. NTIS, PC A03/MF A01.

This report summarizes the development of a short term model, the primary purpose of which is to predict bituminous coal and lignite consumption patterns, preferably at the State level of detail, under alternative policty scenarios. The model components described are all econometrically based. Alternative methodologies requiring additional research are presented in the final chapter. The development of a coal demand model was based upon perceptions of the unique characteristics of the various demand sectors. Historically, coal demand has been differentiated into four major components: a) coking coal demand; b) retail, manufacturing and other industrial coal demand; c) coal demand by electric utilities; and d) export demand for coal. Due to the marked differences in these four sectors, the variables they depend on, and the quantity and quality of available data, each sector was modelled separately. The demand for coal in the electric utility sector is dependent upon two major factors: electricity production and inventory levels. Chapter III details the methodology developed to forecast electricity generation by state. This variable is integrated with forecasts of inventory level to forecast coal consumption in the utility sector. Additional research recommendations suggested are based upon the availability of additional data resources, the experience and insights gained from the analyses and recognition of the dynamic nature of coal consumption patterns in the United States.

38128 (LA—6915-MS) **Rocky Mountain coal for southern California's coal-fired electric power generation.** Anderson, O.L. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

This report is a scaled-down version of a Study of Alternative Locations of Coal-Fired Electrical Generating Plants to Supply Western Coal to the Department of Water Resources. It covers three aspects of the major report: (1) coal resources in the Upper Colorado Plateau, (2) the possible transportation of those coal resources to southern California, and (3) the cost analyses of the coal transportation. Descriptions of 92 coalfields within an 800-mile radius of the Los Angeles energy market are included. The general legal regulations governing the acquisition and development of coal from state, federal, and private lands are discussed. This report also describes the existing and potential methods of transporting the coal to southern California.

38129 (PB—285944) **Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report.** Gordon, R.L.; Julian, E.L.; Julian, L.C. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Economics). Dec 1976. 346p. NTIS PC A15/MF A01.

Data on western coal availability indicate that low cost resources of such coal are in ample supply to meet demand levels implied by recent energy forecasts. An extensive review of the cost engineering literature on electric power plants leads to the conclusion that while nuclear power appears to have a strong long-run position, the data are subject to considerable uncertainty. A regionally disaggregated simulation of electric utility fuel use shows the wide range of possible coal use patterns that could emerge. Lead times are such that a substantial increase of coal use will occur between now and the middle 1980s but the split of markets between eastern and western coal is unclear. Intensified nuclear competition may restrain subsequent growth in the period 1990-2000, but this is not certain. A method for placing different estimates of synthetic fuel costs on a consistent basis and for testing the sensitivity of such costs to coal prices is presented in the Supplement. This method suggests that earlier studies were overly optimistic about the prospects for synthetic fuels.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 38043

38130 (CONF-790415—31) **Synthetic fossil fuel technologies: health problems and intersociety cooperation.** Gammage, R.B.;

Turner, J.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

The potential health impacts of synthetic fossil fuel products are considered mainly in terms of complex and potentially carcinogenic mixtures of polynuclear aromatic (PNA) compounds. These components of oils and tars present an especially perplexing range of problems to those concerned with health protection. The nature of these problems, such as multifactorial exposure, are discussed within a framework of current and future standards to regulate human exposure. Some activities of government agencies, national laboratories, and professional societies are described. A case can be made for pooling the resources of these groups to achieve better solutions for assessing the acceptability of the various technologies and safeguarding human health.

38131 (PB—283972) **Materials suitable for use inside explosion-proof enclosures. Final report, 7 September 1975—7 March 1976.** Morley, L.A.; Trutt, F.C. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). 7 Apr 1976. 43p. NTIS PC A03/MF A01.

The report defines the extent of problems associated with electric arcing within explosion-proof enclosures containing organic materials. The objective was achieved and the conclusion was reached that inclusion of such materials and water should be limited to as small an amount as practical.

38132 (PB—286006) **Development of an improved methane sampling system. Open file report.** Webb, W.L.; Paskel, M.T. (Bendix Corp., Baltimore, MD (USA). Environmental and Process Instruments Div.). Dec 1977. Contract H0230019. 21p. NTIS PC A02/MF A01.

An electrically powered methane sampling system for application on mining machines was designed, fabricated, and laboratory tested. The system will sequentially draw sample air at a controlled rate from up to three machine positions across the mine face and deliver the air to either an approved methane monitor, methanometer, or flame safety lamp. The prime considerations in the design were to provide an intrinsically safe, water and dust resistant control box and an explosion-proof power box capable of being operated from the various mining power sources. The power box contains an internal battery that provides operating power prior to mining machine startup and after machine shutdown. The internal battery is recharged automatically when mining machine power is available.

REGULATIONS

REFER ALSO TO CITATION(S) 38926

PETROLEUM

REFER ALSO TO CITATION(S) 38878

GEOLOGY AND EXPLORATION

38133 (SAN—1265-8) **Analysis of five-spot tracer tests to determine reservoir layering.** Yuen, D.L.; Brigham, W.E.; Cinco-L, H. (Stanford Univ., CA (USA). Petroleum Research Inst.). Sep 1978. Contract EY-76-C-03-1265. 66p. Dep. NTIS, PC A04/MF A01.

This report presents a computer algorithm for determining the degree of heterogeneity among the layers of a reservoir. The algorithm uses the equations developed by Brigham and Smith that predict the behavior of a tracer slug flowing in a five-spot injection pattern. To illustrate the use and potential problems in the application of this algorithm, examples are presented using five sets of simulated field test data. One example using actual field data is also presented.

38134 Exploration of oil and gas in the Federal Republic of Germany in 1977. Schroeder, L. (Niedersaechsisches Landesamt fuer Bodenforschung, Hannover (Germany, F.R.)). *Erdoel-Erdgas Z.;* **94**: No. 7, 233-243(Jul 1978). (In German).

The search for oil and gas deposits in the Federal Republic of Germany continued in 1977 with 27 completed exploratory wells with 4 new field discoveries, a 14,8% success rate. An encouraging gas find was made in the Rotliegendes with Munster-Nord Z 1. Another good find was Teising 1, which tested gas and some oil in the Ampfinger Sandstein (Eocene). Oil was found in Boerger 7 in the Upper Jurassic and gas was found in Brettorf Z 2 in the Main Dolomite (Zechstein). The reserves discovered with Boerger 7 and Brettorf Z 2 cannot be estimated until extension wells have been drilled. The big exploration efforts done in the German part of the North Sea were totally without success. Reserves recently discovered onshore were not as large as hydrocarbon production in 1977. Therefore oil reserves declined 3.9% to 67.5 x 10^6 t and gas reserves declined 6.6% to 276.6 x 10^9 m^3(Vn).

38135 Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs. Demina, A.M. *Razved. Geofiz.;* No. 72, 10-19(1976). (In Russian).

A technique is described for predicting oil-gas-bearing areas of the Western Bashkirs by means of recognition programs based on geological-geophysical studies. Earlier recommendations are verified to corroborate the favorable outlook in applying mathematical statistics for predictive purposes.

38136 Frequency distortions in a multistrand cable during electrical surveying of wells. Bulanov, N.A.; Gerasimov, N.N. *Razved. Geofiz.;* No. 72, 163-167(1976). (In Russian).

Approximation formulas are presented by means of which it is possible to analyze the frequency distortions occurring in a cable during electric surveying of wells. The equivalent cable scheme is replaced by a symmetrical, T-shaped, 4-pole schematic by means of which it is possible to simplify the technique of calculation.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 38196, 38927, 39235, 39236

38137 (BETC—79/1) **Contracts and grants for coopeative research on enhanced oil and gas recovery and improved drilling methods. Progress review No. 17, quarter ending December 31, 1978.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Mar 1978. 163p. Dep. NTIS, PC A08/MF A01.

This issue contains objectives and summaries of technical progress of field projects and supporting research on chemical flooding, CO_2 injection, thermal/heavy oil (oil sands), Western gas, Eastern gas, improved drilling methods, residual oil, environmental, and effects of enhanced oil recovery chemicals on crude refining. One hundred and two abstracts for 1978 publications on enhanced oil and gas and on drilling equipment and methods are included. (DLC)

38138 (BETC—0001-1) **Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977—September 1978.** Schechter, R.S.; Wade, W.H. (Texas Univ., Austin (USA)). Dec 1978. Contract EW-78-S-19-0001. 61p. Dep. NTIS, PC A04/MF A01.

Many species of monoisomeric alkyl-substituted benzene sulfonates were synthesized and examined at low concentrations. Interfacial tension in particular was studied. Optimum salinity for high surfactant concentrations was defined as the middle of the 3-phase region. Work on surfactant adsorption was focused on a model that can explain maxima and minima in adsorption curves. A model for diffusion and stranding at the aqueous surfactant—oil interface was applied to spontaneous emulsification and extended to systems that form middle-phase microemulsions. (DLC)

38139 (BETC—0007-3) **Study of the potential for future work on methods of determining residual oil. Final report.** Bond, D.C.; Wesson, T.C. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Apr 1979. Contract EW-78-C-19-0007. 106p. Dep. NTIS, PC A06/MF A01.

Sixty ROS experts in 12 oil companies, 2 service companies, and 3 universities were interviewed. Recommendations concerning DOE funding in 18 potential research areas are summarized in Table 1. Recommended funding for projects related to logging methods is approximately $2,400,000. Justification for some of the logging projects is based, in part, on benefits other than improvements in ROS determination. Recommended funding for coring is $400,000; for tracer methods $300,000; for running of suites of ROS methods, $900,000; and for miscellaneous activities (such as a ROS seminar), less than $100,000. The report includes: a brief summary of the state-of-the-art of ROS determination; background information for various projects, with reasons for recommendations; and a list of projects not recommended, with reasons why they were not recommended.

38140 (BETC—2180-4) **Bell Creek residual oil saturation technology test. Project quarterly report for period October 1978—December 1978.** Myal, D. (Gary Operating Co., Englewood, CO (USA)). 18 Jan 1979. Contract ET-78-C-03-2180. 7p. Dep. NTIS, PC A02/MF A01.

Objective is to compare techniques for measuring residual oil saturation, in situ, in a consolidated sandstone reservoir. A test well was drilled and coring runs made during this period. (DLC)

38141 (DOE/ET—00026-8) **Assessment of potential increased oil production by polymer-waterflood in northern and southern mid-continent oil fields. Progress report for the quarter ending December 31, 1978.** (Gruy Federal, Inc., Houston, TX (USA)). 1978. Contract EW-78-C-19-0026. 88p. Dep. NTIS, PC A05/MF A01.

Six tasks are reported on: geological and engineering study of the DOE-Kewanee polymer-augmented waterflood, review of polymer injection program in this field, evaluation of results of polymer-augmented waterflood in this field, review of geological and engineering characteristics of oil fields now in waterflood as candidates for polymer augmentation, review of fields currently under primary production, and determination of ranges of future increased oil production from the polymer-water process in the project area.

38142 (ORO—5301-34) **Oil recovery by carbon dioxide injection. Annual report, July 1977—July 1978.** Guckert, L.G.; SanFilippo, G.P. (Pennzoil Co., Vienna, WV (USA)). Sep 1978. Contract EF-76-C-05-5301. 57p. Dep. NTIS, PC A04/MF A01.

As of July 1, 1978, the project was thirteen months behind the original schedule. This failure to meet the original schedule resulted from a two-month delay due to contract negotiations, a six-month delay before an adequate source of water was developed and made available for injection, and a two-month delay due to a labor strike. The project is now showing a response to waterflood. Further delays might occur in order to properly evaluate oil recovery due to waterflood prior to initiating carbon dioxide injeection. Water injection into the backup injection wells was initiated on October 16, 1976 and water injection into the six pattern injection wells commenced on April 22, 1977. As of July 1, 1978, the cumulative injection into the nineteen injection wells totaled 1,306,966 barrels.

38143 (PB—284019) **Offshore oil development in lower Cook Inlet. Implications for the Kenai Peninsula.** (Alaska Dept. of Community and Regional Affairs, Juneau (USA). Div. of Community Planning). Jun 1978. 360p. NTIS PC A16/MF A01.

The report reviews the effects of outer continental shelf (OCS) development on employment, population growth, transportation, housing, public services, and government finances. For each area of concern, objectives are identified to guide the selection of strategies.

38144 (SAN—1189-3) **Bodcau In Situ Combustion Project. Second annual report, July 1, 1977—June 30, 1978.** Joseph, C.; Pusch, W.H.; Fulford, R.S. (Cities Service Co., Jackson, MS (USA)). Feb 1979. Contract EY-76-C-03-1189. 89p. Dep. NTIS, PC A05/MF A01.

The five patterns included in the Bodcau In Situ Combustion Project are a portion of Cities Service Company's total combustion project on its acreage in the Bellevue Field. Pattern developments on Cities Service Company's Bodcau Fee B lease are shown. Patterns 12 through 16 comprise this demonstration area. The patterns cover 19 productive acres containing approximately 2 million barrels of 19° API crude. Reservoir properties and project area data are presented. Project area structure and net pay isopach maps are presented. Through the first two years of the contract, cumulative air and water injection have been 4,197,331 MCF and 449,605 barrels. Resulting production has been 270,802 barrels of oil. This represents a recovery of 13.6% of the oil in place since the start of combustion. Research conducted has consisted of combustion tube tests, produced fluid analyses and pressure transient tests. Most of the combustion tube runs were conducted during the first year under contract as were the pressure transient tests. Fluid analyses are performed every six months with produced oil, water, emulsions, and gases being sampled and analyzed from each well. The six-year project has an estimated ultimate cost of $8,229,898. Through the first two years, a total of $3,610,356 has been spent. Current operating expenses at the field level for operations, maintenance, well service, and Louisiana Severance Taxes are $5.46 per gross barrel of oil produced.

38145 (SAND—79-0562) **DEEP STEAM Project 16 enhanced oil recovery. Quarterly report, October 1—December 31, 1978.** Bader, B.E.; Fox, R.L.; Johnson, D.R.; Donaldson, A.B.; Krueger, D.A. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract AC04-76DP00789. 27p. Dep. NTIS, PC A03/MF A01.

Objective of DEEP STEAM is to develop the technology required to economically produce heavy oil from reservoirs greater than 2500 feet in depth using steam injection. Current steam flood oil recovery processes are in general limited to shallow (less than 1000 feet) reservoirs. To overcome these limitations, DEEP STEAM is developing (1) methods of decreasing heat loss from injection strings and improving other well completion facilities; and (2) a downhole steam generator that will generate the steam and inject it into the formation at depth. This report covers accomplishments during the fifth quarter of the project and is divided into sections on Project Management, Technoloyg, Fielding, and Supporting Activities.

38146 **Precipitation of hydrolyzed polyacrylonitride in a porous media as applied to the isolation of injected water.** Yusupov, I.G.; Maksutov, R.A.; Kadyrov, R.R.; Kalashnikov, V.M. *Nefteprom. Delo;* No. 3, 8-11(1978). (In Russian).

Results are given for laboratory tests on the filtration and salting our properties of hydrolyzed polyacrylonitrile in a radial model of a seam. A gipan (hyrolyzed polyacrolynitrite) gel, produced by combining gipan with ferric chloride was shown to form a plug in the seam which is not washed out by fresh water during extraction from the model in a seam - borehole system so that it can be recommended for isolating injected water. 1 figure.

38147 **Use of water-soluble petroleum sulfo acids for stimulating well operations.** Intyashin, A.D.; Gorodnov, V.P.; Andriyanov, V.N. *Nefteprom. Delo;* No. 3, 11-12(1978). (In Russian).

The results of laboratory and industrial tests are given on by-products from the Petrov contact - low molecular weight water-soluble sulfo-acids that are highly effective surfactants and acids. Their aqueous solutions were shown to reduce interfacial tension with hydrocarbons up to fractions of the unit din/cm^2, but the reaction rate with carbonate is lower than HCl. 0.5 to 10% aqueous solutions of acid tar are recommended for the treatment of carbonate reservoirs and the pumping of stratal waters. 1 figure.

38148 **Study of hydrophobic acid emulsions.** Kuvandykov, I.Sh.; Klyushin, I.Ya.; Nasyrova, R.G.; Nazarova, E.P. *Nefteprom. Delo;* No. 3, 13-15(1978). (In Russian).

A series of formulas was worked out for hydrophobic acid emulsions with a lifetime regulation on the basis of diluted diesel fuel oil from the Orenburg Oblast fields. The use of diluted oil as the hydrocarbon medium makes it possible to reduce the lifetime of the emulsions up to 2 to 4 hours by reducing the concentration of natural oil stabilizers. That use also makes it possible to reduce the viscosity of the emulsion and the expenditure of the diesel fuel. 2 references, 1 figure.

38149 **Use of polymers for isolating flows of impure water.** Tosunov, E.M.; Komissarov, A.I.; Mollaev, R.Kh. *Nefteprom. Delo;* No. 3, 15-16(1978). (In Russian).

An examination is made of results in the treatment of boreholes with thermoplastic polymers for isolating flows of contaminated waters. Data are presented on conditions for use of polymers (type of reservoir, stratal temperature and pressure, etc), and note is taken of the high degree of effectiveness in the operations undertaken. 2 tables.

38150 **Effect of mineral fillers on the properties of plugging materials.** Derevyankina, L.V. *Nefteprom. Delo;* No. 3, 17-18(1978). (In Russian).

Results are given on studies of the effect that various fillers have on the properties of plugging material made of a phenolformaldehyde oligomer, such as shrinkage, durability, sedimentation stability, rate of cure. 2 figures.

38151 **Determination of stratal pressure with the aid of fluid additions.** Kubagushev, N.G. *Nefteprom. Delo;* No. 3, 18-19(1978). (In Russian).

The essence of determining stratal pressure with the aid of fluid additions consists of pumping oil into the well simultaneously with the well's shutdown. The amount of oil required for pumping is equal to a 3 to 5 yield of the well. The pumping is continued from 1 to 3 hours depending on its rate and volume. After several such procedures the pressure restoration times are reduced as are oil losses associated with the study of the well.

38152 **Process and device for controlling in situ combustion.** Lange, H. (to Deutsche Texaco A.G., Hamburg (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 1,758,806/B/. 14 Apr 1977. 9p. (In German).

A process for controlling in situ combustion with enriched oxygen in an underground natural oil, tar sand or coal deposit which has at least one injection borehole and a conveyor borehole, is described. The injection boreholes are connected with the progressive combustion front, by inlet channels, by which the means of oxidation is introduced. To maintain the inlet channels, combustible gases and vapours are brought through the injection boreholes on periodic exchange for the enriched oxygen, and combustion limited in time is taken through these channels to produce thermal energy. In order to exhaust all areas of the deposits using in situ combustion, in spite of the different arrangement of the deposits, directions of flow at various angles to the axis of flow direction in the field are produced by altering the direction of the combustion plant. The alteration of direction is produced by introducing oxidation material in different quantities and by the choice of an injection borehole, whose position in the field deviates from previous rows of boreholes. The device for carrying out the process is a tube inserted into the

borehole, which is closed at the lower end by a sand filled basket with holes in it, and contains concentrically arranged rising tubes for introducing the oxidation media.

38153 Modified calculation of pressures on the casing in sloped boreholes. Shinkevich, G.G.; Pchelkin, V.N.; Sidnev, V.V. *Neft. Khoz.;* No. 12, 17-18(1977). (In Russian).

A method is presented for a more precise computation of excess pressures acting upon casings in sloped boreholes. An example is given which indicates a reduction in cost and amount of casing when computations are made by the proposed method. Forulae are also given for determining the necessary height of rise of the cement behind the pillar in the sloped borehole. 2 figures.

38154 Study of boreholes by the use of a seam tester on tubes with surface gas emission. Luzyanin, G.S.; Gorshkov, G.F.; Ivenskii, A.P.; Efros, V.L. *Neft. Khoz.;* No. 12, 18-22(1977). (In Russian).

Technology and test results are given for gas flow on a surface through a seam tester on drilling tubes. The method's high degree of effectiveness is demonstrated. 2 references, 3 figures.

38155 Evaluation of final petroleum yield of Ural-Povolzh'e deposits in the early stages of their study. Gomzikov, V.K.; Molotova, N.A. *Neft. Khoz.;* No. 12, 24-26(1977). (In Russian).

A statistical model is proposed for final petroleum yield that was produced from data on the operation of 50 long-term worked deposits of the Ural-Povolzh'e. 4 references.

38156 Pumping an aqueous solution of polyacrylamide. Gabdrakhmanov, A.G.; Asmolovskii, V.S.; Islamov, F.Ya.; Taskhutdinov, R.A.; Mirzagaliev, M.Z.; Rakhimkulov, I.F.; Avanesov, I.G. *Neft. Khoz.;* No. 12, 33-34(1977). (In Russian).

An analysis is made of the current status of an industrial experiment at the Novo-Khazin sector of the Arlanskii field on the pumping of polyacrylamide-thickened water. An examination is made of the engineering system of the proposed apparatus and its advantages over other currently operating machines are demonstrated. 3 references, 1 figure.

38157 Effect of active water-soluble organic compounds of petroleum on salt deposits in petroleum equipment. Akhmetshina, I.Z.; Kagan, Ya.M.; Babalyan, G.A.; Maksimov, V.P.; Marinin, N.S. *Neft. Khoz.;* No. 12, 35-37(1977). (In Russian).

Water-soluble acid compounds of oil that are highly active precipitants of calcium, magnesium and other ions were separated from salt deposits formed on the surface of petroleum equipment from an oil-water-gas medium. The influence of those compounds on salt deposition is demonstrated. 6 references, 2 tables.

PROCESSING

REFER ALSO TO CITATION(S) 38927

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 38916, 38928

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 38916, 38922, 38923, 38928

38158 (DOE/TIC—10078) **Oil and gas replacement cost: development and production. Volume 1. Discussion of methodology, exhibits, and projections. Final report.** (Gruy Federal, Inc., Arlington, VA (USA)). 5 Aug 1977. 112p. Dep. NTIS, PC A06/MF A01.

Objective was to project development and production costs by region and depth interval for the benchmark years 1980, 1985, and 1990. Twenty-four geographical regions were specified and six depth classes defined under historical development costs. Direct operating costs are also covered. (DLC)

38159 (PB—285491) **Planning for offshore oil development. Economic forecasts: lower Cook Inlet lease sale.** (Alaska Dept. of Community and Regional Affairs, Kenai (USA). Div. of Community Planning). Oct 1977. 57p. NTIS PC A04/MF A01.

Over the next 10 years the United States will mount a massive drive to find alternative domestic sources of oil in order to reduce its dependence on imported oil. As part of its planning effort, the Division has prepared a series of forecasts of the economic impact on Alaska of OCS lease sales. This forecast is the third in the series and covers the Federal Lease Sale in the Lower Cook Inlet. It estimates the number of jobs that should be created and the additions to population both Statewide and in the Kenai Peninsula Borough.

38160 (PB—285801) **Effects of Alaskan North Slope crude oil and continued crude oil production at Elk Hills Naval Petroleum Reserve.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 19 Jul 1978. 24p. NTIS PC A02/MF A01.

Examined are: (1) the potential for North Slope crude oil to displace foreign crude oil imports, (2) its resultant impact on our Nation's balance-of-payments, and (3) crude oil production at Elk Hills. Also examined are whether North Slope crude oil is contributing to a surplus of crude oil on the West Coast and the possibilities of alleviating such surplus.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 38164

38161 (ANL/WR—79-3) **Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater.** Harrison, W.; Flotard, R.D.; Ford, D. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 85p. Dep. NTIS, PC A05/MF A01.

Industrywide dollar costs and energy impacts are assessed for (1) granular activated carbon (GAC) in a continuous flow-through system and (2) powdered activated carbon (PAC) fed to an activated-sludge system, where either treatment option is in addition to 1983 BATEA-model requirements. Attainable trace organic removal levels for any given refinery are based upon data from a Class-B refinery that met wastewater BPCTCA in 1977. Scaling is done by assuming that the same percent COD or TOC must be removed as was removed at the Class-B refinery to achieve a like trace-organics removal level. Nationwide application of GAC technology would cost $445 million (capital cost) and $127 million for annual operation (1977 $ basis); corresponding PAC costs are $172 million (capital) and $82 million (annual). Estimated annual energy impacts are: GAC = 2.35×10^6 bbl crude oil (0.44% of annual throughput) and PAC = 5.26×10^5 bbl crude oil (0.0097% annual throughput). PAC technology should be considered for trace organics control throughout the petroleum refining industry and pilot studies should be done to answer outstanding questions. In addition to more favorable capital, operating, and energy costs, major advantages of PAC over GAC include flexibility in varying carbon type and dose, and minimization of the possibility of upset of the activated-sludge process.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38089, 39562, 39609, 39614, 39617, 39618, 39619, 39635

38162 (AD-A—058802) **A study to conduct experiments concerning turbulent dispersion of oil slicks. Final report, October 1976—April 1978.** Lin, J.; Gad-el-Hak, M.; Liu, H. (Flow Research, Inc., Kent, WA (USA)). Apr 1978. Contract DOT-CG-61688-A. 108p. NTIS PC A06/MF A01.

Laboratory experiments were conducted in a wind-wave tank to study the turbulent characteristics in the water boundary-layers under the action of wind and waves and to study the oil dispersion characteristics under the action of breaking waves. Effects of an oil slick on the wind-waves or mechanically-generated waves with wind were also investigated. The objective was to understand by means of laboratory experiments the behavior of oil dispersion in the upper ocean. Two new instruments, a laser Doppler velocimeter and a photodiode wave guage, have been developed to measure remotely the velocity and the vertical displacement of the water surface. The two new techniques and the experimental results are described in detail. For field application, empirical formulas were derived from the laboratory results. (Author)

38163 (PB—283677) **Managing oil and gas activities in coastal environments.** Longley, W.L.; Jackson, R.; Snyder, B. (RPC, Inc., Austin, TX (USA)). Jun 1978. Contract DI-14-16-0008-2152. 75p. NTIS PC A04/MF A01.

In order to minimize disruption of indigenous wildlife, natural land formations and water flows in coastal areas, suggestions are offered to oil and gas developers. Coastal ecosystems are grouped into uplands, seasonally flooded wetlands, saturated wetlands, and open water. Characteristic vegetation, animals, water regimes and management practices are described. The impacts of petroleum development activities, ranging from pre-exploration surveys through termination of production are viewed in various ecosystems; comments and suggestions are included to help mitigate the effects.

38164 (PB—283719) **Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final**

report. Liroff, S.D. (Teknekron, Inc., Berkeley, CA (USA). Resource Management Div.). Mar 1978. 282p. NTIS PC A13/MF A01.

This report is based on a review of the Waste Oil Rerefining Industry. The analysis assesses the industry's current health, and glimpses into the future by looking at five different issue areas critical to the industry and useful to environmental policymaking as well. These five areas include: (1) An inventory and assessment of several rerefining technologies; (2) A financial analysis of several rerefining technologies; (3) An analysis of alternative futures of the rerefining industry; (4) The disposal of acid sludge; and (5) State and local governments as a future market for rerefined waste oil. Results of the analysis show the potential impacts of the Resource Conservation and Recovery Act of 1976 (PL 94-580) on the industry, and the ability of the industry to cope with RCRA by analyzing several industry alternatives in the face of potential RCRA regulations. Finally, the potential for establishing recycled oil programs is evaluated for each of the 48 continental United States.

38165 (PB—283890) **Environmental assessment of an active oil field in the northwestern Gulf of Mexico, 1976—1977. Annual report.** Jackson, W.B. (National Marine Fisheries Service, Galveston, TX (USA). Galveston Lab.). Dec 1977. 756p. NTIS PC A99/MF A01.

The objectives of the study are: (a) to describe, for an active oil and gas producing field and an unaltered area, the existing ecosystems and the variability in their major components in time and space; and (b) to compare the concentrations of pollutants in the sediments, water and biota in an active field with those in an unaltered area and identify those changes associated with oil and gas exploration and production. Topic areas covered include: sedimentology, geochemistry and trace metals; distribution and abundance of macrobenthic and meiobenthic organisms; demersal fishes and macro-crustaceans; recreational fisheries and the distribution of predatory pelagic fishes; ichthyoplankton; effects of offshore oil field structures and their biotic environment--benthos and plankton; the effect of structures on migratory and local marine birds; hydrography of the Buccaneer oil field and adjacent waters; hydrocarbon levels and pathways in the major components of a marine ecosystem; and total organic carbon and carbon isotopes of sediments.

38166 (PB—284065) **Thermal regeneration of activated carbon.** Hemphill, L. (Missouri Univ., Columbia (USA). Dept. of Civil Engineering). May 1978. 116p. NTIS PC A06/MF A01.

Ecologically, petrochemical wastes constitute a major hazard since waste materials contain relatively large amounts of non-biodegradable and toxic materials which may be discharged continuously. A three-part experimental study of activated carbon adsorption and thermal regeneration has been completed. The project included an experimental pilot plant thermal regeneration study to determine specific thermal regeneration characteristics of selected petrochemical waste materials and a low-pressure thermal investigation. Results of these studies showed: (1) Small polar molecular species, or species highly soluble in water, are resistant to carbon sorption. (2) Extreme acidic or basic waste streams may require pH adjustment to promote carbon sorption. (3) Batch isotherm values provide basic information relative to activated carbon-petrochemical waste column design. (4) Vacuum regeneration of petrochemical saturated activated carbon is effective and efficient. With most sorbent-sorbate combinations tested, the carbon sorbent could be regenerated to 95% of original sorption capacity. (5) Temperature required for carbon regeneration was a function of waste type (composition) and sorption capacity. The report describes experimental methods of differential thermal analysis, vacuum thermal regeneration, isotherm and column derived sorption values, and quantitative relationships of temperature and thermal regeneration response.

38167 (PB—285211) **Response of a salt marsh to oil spill and cleanup: biotic and erosional effects in the Hackensack Meadowlands, New Jersey. Final report, May 1976—December 1977.** Dibner, P.C. (URS Research Co., San Mateo, CA (USA)). Jun 1978. Contract EPA-68-03-2160. 62p. NTIS PC A04/MF A01.

This study addresses the biological and erosional response of portions of the Hackensack Meadowlands estuarine marsh to the Wellen Oil Company number 6 crude oil spill of late May 1976, and the subsequent cleanup operations. Cleanup included cutting and removal of oiled grasses of the species Spartina alterniflora from the bank of the Hackensack River. Data were gathered from several locations along the river bank and in the inner marsh during four sampling sessions, at approximately 4 month intervals, throughout the year following the spill. The productivity of the marsh plants, the composition of marsh soil invertebrate communities, the presence of oil in the substrate, and erosional trends were monitored. Results suggest that cutting heavily oiled Spartina soon after contamination saved the plants from dying by root suffocation.

38168 (PB—285408) **Alaska OCS socioeconomic studies program. Technical report number 17. Monitoring petroleum activities in the Gulf of Alaska and lower Cook Inlet between April 1975 and June 1978. Final report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Dames and Moore, Anchorage, AK (USA)). Aug 1978. Contract DI-AA550-CT6-61. 82p. NTIS PC A05/MF A01.

This report presents data on all types of petroleum development activity in the stated areas as well as descriptive information on procedures and activities and impacts of these activities on local communities and their planning responses.

38169 (PB—285409) **Alaska OCS socioeconomic studies program. Technical report number 18. Beaufort Sea petroleum development scenarios: economic and demographic impacts. Technical report.** (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Alaska Univ., Anchorage (USA). Inst. of Social and Economic Research). Jun 1978. Contract DI-AA550-CT6-61. 300p. NTIS PC A13/MF A01.

Using the model of the Alaskan economy and population developed in the Man-in-the-Arctic Program of the Institute of Social and Economic Research, forecasts of the economic, fiscal, and population effects of four alternative petroleum development scenarios were made. The impacts of each of these scenarios is described in terms of change in aggregate indicators, causes of this change, the fiscal sector of the state, structure of the economy, composition of population, and the effect on three regions of the state.

38170 (PB—285679) **Techniques for mixing dispersants with spilled oil. Final report 1976.** Smith, G.F. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Jun 1978. Contract EPA-68-03-0490. 50p. NTIS PC A03/MF A01.

The effective use of some oil spill dispersants requires the addition of mixing energy to the dispersant-treated slick. Various methods of energy application have included the use of fire hose streams directed to the water surface, outboard motors mounted on work boats, and the five-bar gate, a pallet-like device towed on the surface behind vessels of opportunity. The U.S. Environmental Protection Agency sponsored this test program at their Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) to evaluate the above devices as well as a modified version of the five-bar gate. Three test fluid mixtures with different interfacial tensions were distributed onto the water surface, and each mixing device was towed through them at speeds from 1.02 m/s to 2.54 m/s in three wave conditions. Droplet penetration was documented via underwater photography. Analysis of the results showed that the modified five-bar gate produced the greatest overall penetration (2.4 m) at a tow speed of 2/0m/s. In general, performance was unaffected by wave action, and variations in interfacial tension produced no observable trend among all devices.

38171 (PB—285931) **Oil spills: the policy of prevention and the strategy of recovery.** Conrad, J.M. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). Oct 1977. Contract DI-14-34-0001-6022. 97p. NTIS PC A05/MF A01.

A model of offshore petroleum production is constructed which contains a stochastic spill process where the amount spilled in the current period is conditional upon previous period production and other distribution parameters. The role of liability rules within the stochastic spill model is examined and an optimal liability rule derived. Existing and proposed federal legislation as well as current international conventions are discussed and their efficacy as a policy for spill prevention is evaluated. A model for the optimal location of recovery resources is developed and applied to coastal Massachusetts. Southern Cape Cod and the islands of Martha's Vineyard and Nantucket were found to be underprotected.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 38927

38172 (AD-A—059655) **Offshore vessel traffic management (OVTM) study. volume i. executive summary. Final report Aug 77-Jun 78.** Bland, R.; Kalafus, R.; Wisleder, R.; Frankel, F.; Prerau, D. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Aug 1978. 34p. NTIS PC A03/MF A01.

The objectives of the study were: (1) to analyze the causes of tanker and other vessel casualties that could potentially result in oil pollution, and (2) to evaluate various alternative vessel traffic management systems and techniques for the prevention of oil-polluting casualties in the U.S. offshore waters. The geographical areas of interest are the waters from the U.S. coast out to 200 NM around the contiguous 48 states, Hawaii, Puerto Rico, the Virgin Islands and Alaska, except the area north of the Aleutian Islands. Three types of casualties are addressed in the study: groundings, collisions, and rammings. Vessels included in the study are tank vessels (tankers and tank-barges) over 1000 gross tons. The analysis of the causes of tank vessel casualties is performed mainly with the Coast Guard Merchant Vessel Casualty Report (MVCR) data base covering the period from July 1971 to October 1977. Other data sources surveyed

include: the Lloyd's Weekly Casualty Reports, the Tanker Casualty Library of Marine Management Systems, Inc., and the Coast Guard Pollution Incident Reporting System. The nature and characteristics of tank vessel casualties that occur in the U.S. offshore waters are described. Systems and techniques considered as alternatives for preventing these casualties are identified, evaluated against each casualty and given an overall rating of casualty prevention effectiveness based on criteria which are defined. The promising systems are selected and conceptual descriptions are presented including the operational features, technical description, cost, staffing and training required, and legal implementation considerations.

38173 Operational features of boreholes equipped with heat-insulated throwout lines with accessory thermal minerals. Gaziyants, A.P.; Raznitsin, V.V.; Kulidzhanov, Yu.Ya.; Korchagin, Yu. S.; Kharchev, V.F. *Neft. Khoz.;* No. 12, 39-41(1977). (In Russian).

An intra-industrial assembly arrangement that provides for the laying of several oil pipelines in a single heat-insulated packet with accessory minerals along which a liquid collant is supplied was proposed for the purpose of reducing oil viscosity and paraffin deposition. 2 figures, 1 table.

PROPERTIES

REFER ALSO TO CITATION(S) 38084

COMBUSTION

38174 (AD-A—059381) **Combustion kinetics of selected aromatic hydrocarbons. Interim report 1 Jun 77-13 May 78.** Matula, R.A.; Farmer, R.C. (Louisiana State Univ., Baton Rouge (USA). Div. of Engineering Research). Jun 1978. 30p. NTIS PC A03/MF A01.

The primary objective of the research program is to develop an understanding of the high temperature pyrolysis, oxidation and carbon formation processes in selected aromatic-hydrocarbon/air-combustion systems. The results of this study can be subsequently utilized to optimize the use of high-aromatic-content synthetic jet-fuels in both present and future jet combustors. Specific objectives of the research are to: study the kinetics of aromatic hydrocarbon pyrolysis in temperature and ranges of interest; study the ignition and oxidation of aromatic hydrocarbon-air systems; measure the critical fuel-oxidizer equivalence ratio for incipient soot formation in aromatic hydrocarbon-air mixtures; and develop quasi-global and/or detailed oxidation mechanisms for these aromatic hydro-carbons based on experimental data and computer modeling of the reaction systems. (Author)

NATURAL GAS

38175 Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT. Pangborn, J.B.; Scott, M.I. Chicago, IL; Inst. of Gas Technology (1979). 12p. (CONF-790337—3). NP.

From New fuels and advances in combustion technologies symposium; New Orleans, LA, USA (26 Mar 1979).

This paper addresses two topics: (1) the recent IGT survey of U.S. gas transmission and distribution companies and their plans for gas supplementation, and (2) a comparison between interchangeability determinations based on calculated indexes and experimental observations. In 1977, our written survey with replies from 88 gas companies revealed that 39% of the respondents now supplement or plan to supplement their gas with LPG-air mixture (not just peak-shaving), while another 21% use or plan to use LNG. From our work on gas interchangeability, we believe that laboratory determinations of gas interchangeability on sensitive or critical appliances are very important whenever calculated indexes (Weaver or A.G.A.) show possible problems or marginal interchangeability.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 38134, 38135, 38136

DRILLING, PRODUCTION, AND PROCESSING

38176 (CONF-7611113—, pp 10p, Paper 3) **Natural gas dehydration with solid desiccant.** Cummings, W.P. 1976.

From 12. annual pipeline operation and maintenance institute; Liberal, KS, USA (16 Nov 1976).

The latest technological developments in natural gas dehydration with solid desiccants is discussed and it is shown how the changes in the type of dehydration at, or near, the origin of the gas, have made life easier for the pipeline operators. As more and more of the gas is fed to the lines at lower water content and lower hydrocarbon content, problems of hydrates, corrosion, liquid condensation, and related troubles have been reduced. The design of modern dehydrators is also discussed.

38177 (ORO—5194-2(Vol.1)) **Analysis of the structural parameters that influence gas production from the Devonian shale. Volume 1. Executive Summary and Task Reports. Annual progress report.** Shumaker, R.C.; de Wys, J.N.; Dixon, J.M. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). Oct 1978. Contract EY-76-C-05-5194. 86p. Dep. NTIS, PC A05/MF A01.

The first portion of the report, from the Executive Summary (page 1) through the Schedule of Milestones (page 10), gives a general overview which highlights our progress and problems for the second year. The Task report portion of the text, written by individual task investigators, is designed primarily for scientists interested in technical details of the second year's work. The second portion of the report consists of appendices of data compiled by the principal investigators.

MARKETING AND ECONOMICS

38178 (PB—283875) **Natural gas shortage. Final report.** Kapiloff, L.; Nimmo, R.; Suitt, T.; Warren, C. (California Assembly Permanent Subcommittee on Energy, Sacramento (USA)). 1977. 90p. NTIS PC A05/MF A01.

This report discusses California's natural gas crisis with particular emphasis on the role that should be played by liquefied natural gas in California's energy future.

38179 (PB—283975) **The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report.** Young, K.B. (Texas Tech Univ., Lubbock (USA). Dept. of Agricultural Economics). Jul 1977. 56p. NTIS PC A04/MF A01.

The Texas High Plains has been developed into a highly productive crop-producing region partly by exploiting the groundwater reserves for irrigation and by using relatively low cost natural gas to operate the irrigation wells. The life of the High Plains as a major production region is limited by the serious problem of continued overdraft on the Ogallala underground aquifer. However, the recent phenomenon of accelerating natural gas prices poses an even more serious threat to the continued viability of agriculture in the Texas High Plains. The overall objective of the study was to determine the impact of rising natural gas prices on agricultural production in the Texas High Plains and adjacent producing regions which compete in production of major Texas crops.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 38599, 39619

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 38137

38180 (SAND—79-0056) **Enhanced gas recovery program. Third annual report, October 1977—September 1978.** Northrop, D.A.; Schuster, C.L. (eds.). (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 124p. Dep. NTIS, PC A06/MF A01.

Massive hydraulic fracture mapping field experiments continued in FY 78 with the major activity being an improvement program for the surface electrical system. The potential measurement boxes were modified to accept two different radial inputs and to be continuously calibrated. Hydraulic and explosive fracturing experiments have been conducted adjacent to an existing tunnel complex at DOE's Nevada Test Site and have been directly observed by subsequent mineback activities. Evaluation of a proppant distribution experiment has revealed a complex fracture system created in a complex geologic region with numerous faults and sharp variations in in-situ stress. Evaluation of an experiment to examine hydraulic fracture behavior at a geologic formation interface is underway. Initial mineback has revealed that a fracture initiated in an ashfall tuff formation broke upwards into an overlying welded tuff formation with significantly different properties, most notably an order of

magnitude higher modulus; coring is underway to further delineate the fracture systems. The question of fracture propagation at an interface is being addressed by analytical, numerical and experimental techniques. Small volume hydraulic fracturing is being developed as a diagnostic tool to measure in-situ stresses and to evaluate expected fracture behavior. In conjunction with a nuclear containment program, it has been confirmed that confined explosive detonations produce containment cages of high residual stress around the cavity which severely inhibit the formation of radial fractures in communication with the cavity. In conjunction with a development program, it was shown that a tailored impulse from a propellant can create multiple fractures from a wellbore; twelve fractures (0.6 to 8 ft) were produced from a 20 lb propellant charge which gave pressure loading rate of 20 psi/sec and a peak pressure of 13,800 psi and no evidence of wellbore enlargement or crushing.

38181 (UCRL—50036-78-4) **LLL gas stimulation program. Quarterly progress report, October—December 1978.** Hanson, M.E.; Anderson, D.G.; Shaffer, R.J.; Montan, D.N.; Thorson, L.D.; Lin, W.; Haimson, B.C.; Cleary, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Feb 1979. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

Two-dimensional models were used to analyze the behavior of hydraulically pressurized fractures near well bonded interfaces that are located between two materials. Specifically, ways of how existing small fractures interact with a pressurized fracture were analyzed, including some effects of branching and blunting of the pressurized fracture. The strain field along on interface caused by a pressurized fracture near that interface is also discussed. Analysis of the well-test data from the Mobile Piceance Creek Unit Well F31-136 was continued to analyze the effects of a finite conductivity fracture. Results of this analysis show that it is impossible to uniquely determine whether the pressure buildup characteristics are controlled by skin-damage "scum" or by finite conductivity in the crack. In addition, polyaxial experiments to determine the effects of principal stress magnitudes in Dresser Basalt confirm that fracture geometry is strongly controlled by principal stress magnitude. 22 figures, 2 tables.

38182 (UCRL—81707) **Some results from continuum mechanics analyses of the hydraulic fracturing process.** Hanson, M.E.; Shaffer, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 23p. (CONF-790514—1). Dep. NTIS, PC A02/MF A01.

From Symposium on low-permeability gas reservoirs; Denver, CO, USA (20 May 1979).

Theoretical, numerical models are being developed to analyze the hydraulic fracturing process. Applications include: fracturing near interfaces, effects of existing fractures near interfaces, pore-pressure effects, and stress-field changes due to embedded lenses. For a well-bonded interface, the calculations indicate that the stress-intensity factor of the leading crack tip decreases as the crack approaches a higher modulus material. As the tip crosses the interface into the higher modulus material, the stress-intensity factor abruptly increases to a higher value than it had in the lower modulus material. When the situation is reversed, the intensity factor increases as the tip approaches the interface and then abruptly decreases when the tip crosses the interface. Further calculations show that when existing cracks are present near the interface the effects of the change in material properties across the bonded interface are reduced. The analysis shows that increases in pore pressure due to leakage of fluids from the fracture into the surrounding media causes the stress-intensity factor to drop; a decrease in the stress-intensity factor means a reduction in the tendency to break. The stress-field disturbance caused by lenses of one material that are embedded in another material are analyzed, and calculations show that in regions that are not tectonically relaxed the stress field is modified by the lenses. It is concluded that the fracture geometry is modified by the presence of embedded lenses under these conditions. 17 figures.

TRANSPORT, PIPELINES, AND HANDLING

38183 (CONF-7611113—) **12th annual pipeline operation and maintenance institute. Petroleum Institute booklet: selected papers of the Heart of America.** (Kansas Univ., Garden City (USA). Southwest Kansas Regional Center). 1976. 151p. TIC.

From 12. annual pipeline operation and maintenance institute; Liberal, KS, USA (16 Nov 1976).

The proceedings contain 11 selected papers dealing with various aspects of the operation and maintenance of petroleum and natural gas pipelines. Specific subjects dealt with include new flexible couplings for piping applications with severe operational requirements; microwave welding of natural gas pipelines in the field; natural gas dehydration with solid desiccant that helps the pipeline operators deal with problems of hydrates corrosion and liquid condensation; river crossing by a new horizontal hole technique; instruments for leakage detection; and external corrosion control. Selected papers were indexed.

38184 (CONF-7611113—, pp 12p, Paper 1) **Flexible connectors.** Reinhardt, C.M. (Murdock Machine and Engineering Co., Irving, TX). 1976.

From 12. annual pipeline operation and maintenance institute; Liberal, KS, USA (16 Nov 1976).

This paper covers a unique flexible coupling called LOCKSEAL which was developed for piping applications where either high pressures, high loads, long life, or severe operational requirements are involved. Although the LOCKSEAL coupling design appears to be more complex than competitive couplings, it is in fact quite simple to manufacture and requires no service or maintenance in use. These advantages plus key operational capabilities make it extremely attractive for use in specialized pipeline applications. The paper deals with the pipejoint design, present and potential applications, and special use of the LOCKSEAL elastomeric structure principles, many of which are associated with the oil and gas industry.

38185 (CONF-7611113—, pp 4p, Paper 5) **Boring proves exciting way to cross river.** Hughett, J. (Arkansas Louisiana Gas Co., Shreveport). 1976.

From 12. annual pipeline operation and maintenance institute; Liberal, KS, USA (16 Nov 1976).

The use of the horizontal drilling technique for making river crossings during the construction of a natural gas pipeline in Louisiana is described. The technique, which involves a new idea for drilling a horizontal hole under rivers and canals, was developed by combining a number of techniques and special equipment already in use for drilling oil and gas wells, in mining operations, and boring holes for pipelines under highways. A specially designed drilling rig and some key factors involved in this drilling technique are detailed.

OIL SHALES AND TAR SANDS

38186 (PB—283817) **The hydraulic transportation of oil shale. Research report.** Link, J.M.; Faddick, R.R.; Pouska, G.A.; Gusek, J.J. (Colorado School of Mines, Golden (USA). Research Inst.). 22 Jan 1977. Contract H0166065. 384p. NTIS PC A17/MF A01.

A program to investigate pipeline behavior of raw and spent oil shale slurries was performed for the Federal Bureau of Mines. Slurries were recirculated in pipeline loops with 150- and 200-mm-wide horizontal test sections and 150-mm-wide vertical test section. Slurry concentrations from 10 to 60 wt % were investigated. Critical and deposition velocities were observed. Head losses were measured at various velocities. Rheology measurements were made on representative homogeneous samples from the pipeline. From these data, pipeline energy requirements were predicted by computer and compared with pipeline data. Computer programs were also used to analyze pipeline data for two flow models. The economics of slurry transport of raw and spent shale were examined. Cost estimates encompassed a range of pipe widths to transport a wide range of throughputs of both raw and spent shale. Similar estimates were made for conveyor belt systems to provide a valid cost comparison.

RESERVES AND EXPLORATION

38187 (N—78-31584) **Energy analysis and oil shale reserves.** Hemming, D.F. (Open Univ., Milton Keynes (UK). Energy Research Group). Feb 1978. 25p. NTIS PC A02/MF A01.

Resources and reserves of shale oil throughout the world are reviewed with the United States having the largest known resources. Locations in the U.S. of these reserves are noted. An assessment of the ultimate recoverable reserves of oil available from oil shales in the world and in the U.S. is made with the economically and efficiently recoverable reserves also being given.

DRILLING, FRACTURING, AND MINING

38188 (LA-UR—79-646) **Calculation of explosive rock breakage: oil shale.** Johnson, J.N. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-790606—1). Dep. NTIS, PC A02/MF A01.

From 20. US symposium on rock mechanics; Austin, TX, USA (3 Jun 1979).

Improved efficiency in explosive rock breakage becomes increasingly important as mining costs and the need to tap under-

ground resources continue to grow. Industry has recognized this need for many years and has done a great deal in developing new products and new blasting techniques, generally by purely empirical means. One particular application that has received added attention within the past several years, and one that lends itself to a more objective theoretical study, is explosive fracture of oil shale for conventional and in situ fossil energy recovery. Numerical calculation of oil shale fracturization with commercial explosives has the potential to add to an objective understanding of the breakage process. Often, in such numerical studies, only one or two parts of the total problem are addressed with any degree of sophistication or completeness. Here an attempt is made to treat the entire problem, i.e., explosive characterization, constitutive behavior of intact rock, and a mathematical description of rock fracture. The final results are two-dimensional calculations of explosively induced fracture damage in oil shale.

38189 (SAND—78-2268C) **Techniques and problems relating to in situ measurment of stress waves in rubblization experiments.** Reed, R.P.; Boade, R.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 13p. (CONF-790606—7). Dep. NTIS, PC A02/MF A01.

From 20. US symposium on rock mechanics; Austin, TX, USA (3 Jun 1979).

Stress waves propagating in rock adjacent to a rubblizing explosion can be monitored by several contemporary techniques. Measured properties of the waves are used to evaluate existing and improved fracturing methods and to document actual conditions of tests in the field. To be useful and economically justified, the measurement tools must be appropriate for the test objectives, they must be properly placed, and necessary conditions of application must be enforced. This paper describes conditions of the experiment and usefully measured properties of the stress field. It reviews the utility, capabilities, and conditions for application of time-of-arrival, displacement, velocity, acceleration, stress, and strain sensors applied to monitoring of rock rubblization experiments.

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 38070, 38152, 38317

38190 (FE—1747-1) **BX in situ oil shale project. Quarterly technical progress report, March 1—May 31, 1977.** (Equity Oil Co., Salt Lake City, UT (USA)). 10 Jun 1977. Contract ET-78-F-03-1747. 10p. Dep. NTIS, PC A02/MF A01.

Objective is to demonstrate the feasibility of using superheated steam as a heat-carrying medium to retort in-situ the oil shale in the Green River Formation "leached" zone and provide a mechanism for the recovery of this shale oil with a minimum impact on the environment. Specific tasks included: The drilling and coring of two core holes for site evaluation; the design of the vertical communication test; discussions concerning the laboratory experimentation program; reactivation of a mathematical model for analyzing in situ retorting; and the preparation of an Environmental Research Plan (ERP) for the project.

38191 (FE—2346-34) **Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, July—September 1978.** Washington, L.J. Jr. (Dow Chemical Co., Midland, MI (USA)). 19 Oct 1978. Contract EX-76-C-01-2346. 52p. Dep. NTIS, PC A04/MF A01.

The objective of this contract is to test the technical feasibility for the in situ processing of the Antrim oil shale within the Mississippian—Devonian black shale sequence of the Michigan Basin to produce energy values. In the report quarter explosive fracturing experiments were conducted in the wells involved in the explosive underream series and in the hydrofracture series. In total, four successful shots were made. In Well No. 301, a 20 foot section of well bore was enlarged to almost three times its original volume by the detonation of 1500 pounds of explosive. Wells No. 101, 104, and 106 were also explosively fractured. Preparations for fracturing Wells No. 103 and 105 are complete. In lab tests for the chemical underream experiment, a 4 foot zone was found to have a uniform and high hydrochloric acid solubility. Notching, fracturing, and acid underreaming experiments will be concentrated in this area. Data from the extraction trials on the front site have been compiled and plotted. A topical report on this experiment is being prepared. Two new methods of igniting shale were tested. Shale characterization and resource inventory activities continued at four major Michigan universities.

38192 (SAND—79-0746C) **Use of electrical geophysical techniques to map and monitor in situ oil shale recovery processes.** Bartel, L.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 25p. (CONF-790440—2). Dep. NTIS, PC A02/MF A01.

From 12. oil shale symposium; Golden, CO, USA (18 Apr 1979).

The electrical conducting property of the in situ coal gasification and oil shale retort reaction zones forms the basis for using electrical geophysical prospecting techniques to map and monitor these in situ processes. The electrical geophysical techniques include: mise-a-la-masse, Schlumberger, and a borehole electrical survey. The field measurements are supported by extensive model calculation and data reduction efforts. The in situ coal gasification reaction boundaries have been successfully delineated using the mise-a-la-masse technique and a ridge regression data inversion algorithm. The electrically determined boundaries at various times during the process are in very good agreement with boundaries determined from thermal data. These electrical techniques are presently being used to monitor the in situ oil shale retort reaction zone. This retorting experiment is being conducted by the Laramie Energy Technology Center at a site near Rock Springs, WY. Monitoring system design, pretest data, and model calculation results for monitoring the retort will be reported in this paper.

38193 (TID—28955) **Oil shale in situ research and development. Quarterly report No. 1, August 1—October 31, 1977.** Graf, G.L. (Talley Energy Systems, Inc., Scottsdale, AZ (USA)). 1977. Contract ET-77-C-03-1791. 25p. Dep. NTIS, PC A02/MF A01.

The Talley-Frac Retort Site is in Sweetwater County, Wyoming. Work reported includes rock mechanics and fracture, proposed drilling, environmental studies, retort design and evaluation, seismic system, and explosive characterization. (DLC)

38194 (TID—28958) **Oil shale in situ research and development. Quarterly report No. 3, February 1—April 30, 1978.** Graf, G.L.; Richardson, W.B.; Morris, J.; Fricke, L. (Talley Energy Systems, Inc., Scottsdale, AZ (USA)). 1978. Contract ET-77-C-03-1791. 75p. Dep. NTIS, PC A04/MF A01.

The in-situ shale oil recovery project is located near Green River, Wyoming. This document relates to site preparation, hydrofracture activity, pre-hydraulic fracturing studies, instrumentation, detonator, coproduced water, and modeling efforts. Well pattern, anomalous water/entrained sand flow, water quality analysis, core description, and coproduced water are also covered in appendices. (DLC)

38195 Method for in situ heat processing of hydrocarbonaceous formations. Bridges, J.; Taflove, A.; Snow, R. (to IIT Research Inst.). US Patent 4,140,180. 20 Feb 1979. Filed date 29 Aug 1977. 24p.

The disclosure describes a technique for uniform heating of relatively large blocks of hydrocarbonaceous formations in situ using radio frequency (RF) electrical energy that is substantially confined to the volume to be heated and effects dielectric heating of the formations. An important aspect of the disclosure relates to the fact that certain hydrocarbonaceous earth formations, for example raw unheated oil shale, exhibit dielectric absorption characteristics in the radio frequency range. In accordance with the system of the invention, a plurality of conductors are inserted in the formations and bound a particular volume of the formations. The phrase bounding a paricular volume is intended to mean that the volume is enclosed on at least two sides thereof. Electrical excitation is provided for establishing alternating electric fields in the volume. The frequency of the excitation is selected as a function of the dimensions of the volume so as to establish a substantially nonradiating electric field which is substantially confined in the volume. In this manner, volumetric dielectric heating of the formations will occur to effect approximately uniform controlled heating of the volume.

38196 Pumping hot water to increase oil yield from fissured-porous seams with highly viscous oil. Kisilenko, B.E.; Kennavi, F.A.; Ryzhik, V.M. *Neft. Khoz.;* No. 12, 29-32(1977). (In Russian).

An examination is made of a method for improving the working of fissured-porous reservoirs when they are saturated with moderately and highly viscous oil. Theoretical and experimental studies confirm the possibility of significantly increasing oil yield from such seams by pumping coolants into them. 3 references, 3 figures.

SURFACE METHODS

38197 (N—78-31268) **The relative costs of producing syncrude from oil shales of various grades under varying conditions.** Hemming, D.F. (Open Univ., Milton Keynes (UK). Energy Research Group). Jan 1978. 49p. NTIS PC A03/MF A01.

The cost of producing syncrude from oil shales using underground mining and surface retorting and open-pit mining and surface retorting are analyzed. The sensitivity of the calculated cost of production of syncrude to the estimated capital cost of plant and facilities is discussed. The effect on the cost on syncrude production

of a labor rate related to the cost of syncrude is also considered. Appendices cover the energy and labor requirements of producing syncrude from oil shales in various ways.

38198 Substantiation of the technological principles for working bituminous fields of Tataria. Muslimov, R.Kh.; Tronov, A.P.; Fatkullin, A.Kh. *Neft. Khoz.;* No. 12, 26-28(1977). (In Russian).

Proof is offered for the nonrationality of applying the refining technology of the mining industry to the development of bitumens. Substantiation is offered for using thermohydraulic and mechanical thermohydraulic means for refining and preparatory operations in working bituminous seams. 3 references, 3 figures.

REFINING

38199 (PB—284027) **Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976—July 1977.** Cotter, J.E.; Prien, C.H.; Schmidt-Collerus, J.J.; Powell, D.J.; Sung, R. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Apr 1978. Contract EPA-68-02-1881. 83p. NTIS PC A05/MF A01.

A sampling and analysis research program was conducted at the Paraho oil shale retorting demonstration site at Anvil Points, Colorado. The overall objective of the test program was to obtain preliminary quantitative and qualitative measurements of air, water, and solid compositions, and to gain experience that would lead to improved sampling procedures and the determination of priorities for sampling and analysis of shale oil recovery operations. Selection of sample locations was based on need for information on process streams relative to emissions and effluents expected in a full-scale plant. Samples taken included the recycle gases (H2S, SO2, NOx, NH3, and trace organics), recycle condensate, product oil/water, processed shale discharged from the retorts, and dust in the vicinity of crushing, screening, and conveying equipment. A variety of laboratory analysis methods were used, including wet chemical analysis, spark source mass spectrometry, high pressure liquid chromatography, thin layer chromatography, gel permeation chromatography, and gas chromatography/mass spectrometry methods (GC/MS). Condensate water inorganic analyses were done for calcium, magnesium, sodium and potassium salts, ammonia, gross parameters, and trace elements. Condensate and product water samples were also analyzed for organic neutrals (particularly aromatics), organic acids, and organic bases. Elemental determinations of both retorted shale and raw shale particulates were made.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 38195

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 38130

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38199, 39694

38200 (COO—4018-3) **Rehabilitation potential and practices of Colorado oil shale lands. Progress report, June 1, 1978—May 31, 1979.** Cook, C.W. (Colorado State Univ., Fort Collins (USA)). Mar 1979. Contract EY-76-S-02-4018. 363p. Dep. NTIS, PC A16/MF A01.

The following document is a third-year progress report for the period June 1, 1978 to May 31, 1979. The overall objective of the project is to study the effects of seeding techniques, species mixtures, fertilizer, ecotypes, improved plant materials, mycorrhizal fungi, and soil microorganisms on the initial and final stages of reclamation obtained through seeding and subsequent succession on disturbed oil shale lands. Plant growth medias that are being used in field-established test plots include retorted shale, soil over retorted shale, subsoil materials, and surface disturbed topsoils. Because of the long-term nature of successional and ecologically oriented studies the project is just beginning to generate significant publications. Several of the studies associated with the project have some phases being conducted principally in the laboratories and greenhouses at Colorado State Univerisity. The majority of the research, however, is being conducted on a 20 hectare Intensive Study Site located near the focal points of oil shale activity in the Piceance Basin. The site is at an elevation of 2,042 m, receives approximately 30 to 55 cm of precipitation annually, and encompasses the plant communities most typical of the Piceance Basin. Most of the information contained in this report originated from the monitoring and sampling of research plots established in either the fall of 1976 or 1977. Therefore, data that have been obtained from the Intensive Study Site represent only first- or second-year results. However, many trends have been identified in thesuccessional process and the soil microorganisms and mycorrhizal studies continue to contribute significant information to the overall results. The phytosociological study has progressed to a point where field sampling is complete and the application and publication of this materials will be forthcoming in 1979.

38201 (EPA—625/9-77-002) **Environmental sampling of the Paraho Oil Shale Retort Process at Anvil Points.** (Environmental Protection Agency, Cincinnati, OH (USA)). Oct 1977. 19p. Environmental Research Information Center, Cincinnati, OH.

The Paraho program has provided a basis for determining testing priorities and establishing the need for effective, standardized sampling and analysis procedures. A considerable body of information has been gathered on the qualitative nature of various process streams at the Paraho R and D plants. Future work should focus on quantitative determinations of those constituents that may appear in a process residual stream.

38202 (LA—7697) **Assessment and control of water contamination associated with shale oil extraction and processing. Work plan.** Wewerka, E.M.; Wagner, P.; Wanek, P.L. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

The work plan for Los Alamos Scientific Laboratory's research on assessment and control of water contamination associated with shale oil extraction and processing is outlined. There are two tandem tasks in the program, a literature and information review and evaluation and an experimental effort. The experimental work will address environmental control technologies for retort and product water, contamination of ground water by abandoned in situ retorts, raw and spent shale leachates, fugitive emissions from background oil shale retorting, and aquifer bridging during or after shale oil extraction.

NUCLEAR FUELS

38203 (PB—285941) **Nuclear fuel industry data.** (Federal Trade Commission, Washington, DC (USA). Bureau of Economics). Apr 1978. 91p. NTIS PC A05/MF A01.

The publication is a compilation of a series of tables presenting statistical data on the nuclear fuel industry.

RESERVES

38204 Determining the water-insoluble residue in potassium salts by gamma surveying. Mishin, G.T.; Gavrilova, L.I. *Razved. Geofiz.;* No. 72, 160-163(1976). (In Russian).

For potassium salts a relation is established between the concentration of heavy radioelements (uranium—radium and thorium series) and the content of water-insoluble residue, which is mainly the clay-mud fraction. A technique is described for determining the content of insoluble residue by measuring the total gamma-ray intensity by means of a PRKS-2 unit. A presentation is given of the results of experimental studies directed to investigating the content of insoluble residue in salts along a cross-section of exploratory wells. From the results of determining the insoluble residue in potassium salts it is possible to make an accurate judgement about the quality of the salts for commercial use.

EXPLORATION

38205 (AD-A—057797) **Electro-optical detection of uranium-238 decay products in the atmosphere. LIDAR remote sensing techniques are studied to determine effectiveness in detecting uranium ore. Final report February 1976-January 1978.** Solomon, J.E. (California Univ., Davis (USA). Dept. of Land, Air, and Water Resources). 17 Feb 1978. 25p. NTIS PC A02/MF A01.

This study was conducted in two phases. The first phase dealt with theoretical calculations of expected detection sensitivities using LIDAR remote sensing techniques to measure airborne daughter products of 238U. The most promising species for this technique were found to be 214Bi and 210 Pb, with effective photon scattering cross sections of 3.5 time 10 to the -17th power sq cm. and 8 time 10 to the -15th power sq cm. respectively. The theoretical calculations regarding system sensitivity were based on approximate calculations of the appropriate transition probabilities and estimates of the effects of atmospheric fluorescent quenching. Phase two consisted of experimental measurements of the total effective photon scattering

cross sections and the effects of quenching by various atmospheric gases. Results of these measurements indicated that the calculated transition probabilities and effective scattering cross sections, exclusive of quenching, were in reasonable agreement with measured values. However, results of the quenching measurements showed that the original theoretical estimates had underestimated the effects of quenching by more than an order of magnitude. Calculations of expected LIDAR system performance based on the experimentally measured quantities showed that, although the system would be very sensitive by normal standards (1 part in 10 to the 18th power at a range of 180 m), it would still be inadequate to the needs of an aerial survey search for 238U ore deposits. (Author)

38206 (GJBX—33(79)) **Uranium potential and geology of the Challis Volcanics of the Basin Creek-Yankee Fork Area, Custer County, Idaho. Final report.** Siems, P.L.; Albers, D.F.; Malloy, R.W.; Mitchell, V.E.; Perley, P.C. (Idaho Univ., Moscow (USA). Dept. of Geology). Jun 1978. Contract EY-76-C-13-1664. 203p. Dep. NTIS PC E05/MF E05.

Uranium deposits in the area are confined to veins in porphyritic and equigranular phases of quartz monzonite of the Idaho batholith and to stratabound lenses and rolls in a carbonaceous arkosic unit, less than 200 feet thick, that unconformably overlies the batholith and is the lowest stratigraphic unit of the Challis Volcanics. Uranium deposits do not occur in other Challis volcanic units. Geological mapping demonstrates that the area is at the edge of a major eruptive center that built a 100-cubic-mile volcanic edifice. Early pyroclastic activity in the Eocene deposited up to 1,000 feet of water-laid tuff and volcanic sandstones that overlie, in part, the uraniferous arkoses. Glass shards in the tuffs and sandstones are devitrified and carbonaceous material is locally abundant but uranium content of these beds is low. Voluminous lava flows of andesite and dacite were discharged after the early eruptions and cover the area to a maximum thickness of 5,000 feet. They are capped by a 1,000-foot sequence of air-fall and ash-flow tuffs and lapilli tuff from rhyolite to quartz latite in composition. The tuffs were erupted from numerous small vents that are aligned along the northwest, north and northeast trends of faults. These vents were later plugged by late-stage domes and dikes of rhyolite and, rarely, basalt. Shallow, low-grade uranium deposits might be discovered in the quartz monzonite phases but the chief potential lies in the discovery of subsurface bedded deposits in the arkoses beneath the Challis Volcanics cover. A number of areas might contain uranium deposits that are larger than those mined but the discovery of these concealed deposits will be difficult by most conventional prospecting techniques.

38207 (GJBX—43(79)) **Savannah River Laboratory hydrogeochemical and stream sediment reconnaissance. Orientation study data release VII, Wolcott, Vermont, area. National Uranium Resource Evaluation Program.** Jones, P.L.; Price, V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Feb 1979. Contract EY-76-C-13-1664. 38p. (DPST—78-141-2). Dep. NTIS, PC A03/MF A01.

A total of 72 samples were collected at various sites in the area during September 1976. The area was selected for study because uraninite had been reported in a mineralized zone of Udall Mine. Ground-water samples, stream sediment and water samples, and lake sediment and water samples were analyzed. Samples near the mine with high uranium concentration were found. This report includes sample locality maps, uranium distribution maps, tables of water quality and field measurement data, and table of uranium and other elemental concentrations. (DLC)

38208 (GJBX—48(79)(Vol.2)(Atlin)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Atlin Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 92p. Dep. NTIS, PC A05/MF A01.

The flight line profile data and statistical analysis results for the Atlin Quadrangle of southeastern Alaska are presented. (LK)

38209 (GJBX—48(79)(Vol.2)(Bradfield)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Bradfield Canal Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 113p. Dep. NTIS, PC A06/MF A01.

Flight line profile data and statistical analysis results for the Bradfield Canal Quadrangle in southeastern Alaska are presented. (LK)

38210 (GJBX—48(79)(Vol.2)(Craig)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Craig Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 107p. Dep. NTIS, PC A06/MF A01.

This volume contains flight line profile data and statistical analysis results for the Craig Quadrangle in southeast Alaska. (LK)

38211 (GJBX—48(79)(Vol.2)(Juneau)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Juneau Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 135p. Dep. NTIS, PC A07/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results for the Juneau Quadrangle, Alaska.

38212 (GJBX—48(79)(Vol.2)(Ketchikan)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Ketchikan Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 123p. Dep. NTIS, PC A06/MF A01.

Volume 2 presents the flight line profile data and statistical analysis results for the Ketchikan Quadrangle, Alaska.

38213 (GJBX—48(79)(Vol.2)(Petersburg)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Petersburg Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 119p. Dep. NTIS, PC A06/MF A01.

Flight line profile data and statistical analysis results for the Petersburg Quadrangle in southeast Alaska are presented. (LK)

38214 (GJBX—48(79)(Vol.2)(Sitka)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sitka Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 149p. Dep. NTIS, PC A07/MF A01.

Sitka Quadrangle, in Alaska, flight line profile data and statistical analysis results are presented. (LK)

38215 (GJBX—48(79)(Vol.2)(Skagway)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Skagway Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 122p. Dep. NTIS, PC A06/MF A01.

Flight line profile data and statistical analysis results for the Skagway Quadrangle in southeast Alaska are presented. (LK)

38216 (GJBX—48(79)(Vol.2)(Sumdum)) **NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sumdum Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Jan 1979. Contract EY-76-C-13-1664. 115p. Dep. NTIS, PC A06/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results from the aerial gamma-ray and magnetic reconnaissance survey of the Sumdum Quadrangle in southeast Alaska. (LK)

38217 (GJBX—57(79)(Vol.2)(Charlotte)) **NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Charlotte NI 17-2 Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Mar 1979. Contract EY-76-C-13-1664. 203p. Dep. NTIS, PC A10/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results for the Charlotte Quadrangle, North Carolina area.

38218 (GJBX—57(79)(Vol.2)(Knoxville)) **NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Mar 1979. Contract EY-76-C-13-1664. 253p. Dep. NTIS, PC A12/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results for the Knoxville NI 17-1 Quadrangle in Tennessee and North Carolina.

38219 (GJBX—59(79)(Vol.2)(Prescott)) **Airborne gamma-ray spectrometer and magnetometer survey: Prescott Quadrangle (Arizona). Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1979. Contract EY-76-C-13-1664. 393p. Dep. NTIS, PC A17/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results for the Prescott Quadrangle, Arizona.

38220 (GJBX—59(79)(Vol.2)(Williams)) **Airborne gamma-ray spectrometer and magnetometer survey: Williams Quadrangle (Arizona). Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1979. Contract EY-76-C-13-1664. 382p. Dep. NTIS, PC A17/MF A01.

Volume 2 presents the flight line profile data and statistical analysis results for the Williams Quadrangle of Arizona.

38221 (GJO—108(78), pp 73-98) **NURE plans and progress.** Everhart, D.L. (Dept. of Energy, Washington, DC). 1978.

From Uranium industry seminar; Grand Junction, CO, USA (17 Oct 1978).

In the Aerial Surveys, in the conterminous 48 states, the flying has been completed in 89 of the NTMS 1° x 2° NURE

quadrangles and is in progress in 39 more. Complete quadrangle data have already been open filed for 46 additional quadrangles, for a total of 174 for which data-gathering is either complete or in progress. In Alaska, the flying is complete in 42 quadrangles, and quadrangle data have been open filed for 34 more. In the Hydrochemical and Stream Sediment Reconnaissance surveys, in the conterminous 48 states, sampling is complete in 99 quadrangles and in progress in 109 more. Quadrangle data have already been open filed in 12 quadrangles. In Alaska, sampling is complete in 21 quadrangles and in progress in 36 more. Quadrangle data have been open filed in 7 quadrangles. In the category of surface geologic studies, which to date in the NURE program have been defined as topical geologic, geochemical, and remote sensing studies, 59 reports have been open filed, 17 are complete and are in the process of being published, and 26 are in progress. The NURE drilling program to date has been divided into two categories - so called favorability drilling and reliability drilling. Favorability drilling projects have been aimed at testing rock sequences, formations, and/or structures that have been deemed favorable for uranium occurrences. In effect such drilling has provided a data base for DOE's speculative potential resource estimates. Reliability drilling projects have been designed to test the extensions of favorable formations and other rock types or the repetition of favorable characteristics in new areas. This drilling has provided a data base for the probable and possible potential resource estimates. The NURE Technology Applications program to date has accomplished a number of short-term objectives and progress toward longer range objectives is good.

38222 (K/UR—21(Pt.2)) **Hydrogeochemical and stream sediment reconnaissance program in central United States. Semiannual progress report, October 1, 1978—March 31, 1979.** Arendt, J.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 6 Apr 1979. Contract W-7405-ENG-26. 23p. Dep. NTIS, PC A02/MF A01.

Basic data reports were open filed for eight NTMS quadrangles during the reporting period: Sherman, Houston, Ardmore, Emory Peak, Presidio, Enig, Austin, and Lawton. Basic data reports, which have been prepared and are in the process of being open filed, include Wichita, St. Cloud, Ashland, and Clinton. Results indicate that the most favorable areas for the occurrence of uranium mineralization in the open filed quadrangles reported are as follows: Austin Quadrangle, Lawton Quadrangle, Emory Peak Quadrangle. During the period, approximately 13,886 samples of groundwater and stream sediments were collected by the URE Project. Approximately 20,738 samples were analyzed by the URE Laboratory.

MINING

38223 (PB—286034) **Uranium mining and milling. The need, the processes, the impacts, the choices. Administrator's guide. Final report.** (Western Interstate Energy Board, Denver, CO (USA)). May 1978. Contract EPA-68-01-4490. 274p. NTIS PC A12/MF A01.

The primary objective of the Guide is to address the technical, economic, social, and environmental factors that influence uranium mining and the siting of milling facilities in the western United States. Although the Guide is not a regulatory document, the information should be useful to local, state, and federal administrators, legislators, policy makers, planners, and regulators involved in the review or approval process for uranium projects. The information should also be of interest to citizens who would be affected by a proposed project. The Guide also highlights information that is considered by industry during the planning process. For example, site-specific aspects of mill tailings management are receiving increased attention from regulators and industry, and some earlier tailings disposal practices are no longer acceptable. A secondary objective of the Guide is to inform developers of the various options that may be available when planning uranium development projects. Although the location of the mine is fixed, there are options available in the design of the mill, such as alternative sites, process methods, waste disposal locations and pollution control techniques.

38224 (PB—286520) **Development document for the effluent limitations and guidelines for the ore mining and dressing point source category. Volume I. Final report.** Jarrett, B.M.; Kirby, R.G. (Environmental Protection Agency, Washington, DC (USA). Effluent Guidelines Div.). Jul 1978. 424p. NTIS PC A18/MF A01.

To establish effluent limitation guidelines and standards of performance, the ore mining and dressing industry was divided into 41 separate categories and subcategories for which separate limitations were recommended. This report deals with the entire metal-ore mining and dressing industry and examines the industry by ten major categories: iron ore; copper ore; lead and zinc ores; gold ore; silver ore; bauxite ore; ferroalloy-metal ores; mercury ores; uranium, radium and vanadium ores; and metal ores, not elsewhere classified ((ores of antimony, beryllium, pltinum, rare earths, tin, titanium, and zirconium). The subcategorization of the ore categories is based primarily upon ore mineralogy and processing or extraction methods employed; however, other factors (such as size, climate or location, and method of mining) are used in some instances. With the best available technology economically achievable, facilities in 21 of the 41 subcategories can be operated with no discharge of process wastewater to navigable waters. No discharge of process wastewater is also achievable as a new source performance standard for facilities in 21 of the 41 subcategories.

FEED PROCESSING

REFER ALSO TO CITATION(S) 38223, 38236, 38287

ENRICHMENT

REFER ALSO TO CITATION(S) 38290

38225 **Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP.** Steinberg, M.; Powell, J.R.; Takahashi, H.; Grand, P.; Kouts, H.J.C. (Brookhaven National Lab., Upton, N.Y. (USA). Dept. of Nuclear Energy). *Atomkernenergie;* **32**: No. 1, 39-48(1978).

From International workshop-thinkshop on emerging concepts in advanced nuclear energy systems analysis; Graz, Austria (29 - 31 Mar 1978).

A linear accelerator fuel generator is proposed to enrich naturally occurring fertile U-238 or thorium 232 with fissile Pu-239 or U-233 for use in LWR power reactors. High energy proton beams in the range of 1 to 3 GeV energy are made to impinge on a centrally located dispersed liquid lead target producing spallation neutrons which are then absorbed by a surrounding assembly of fabricated LWR fuel elements. The accelerator-target design is reviewed and a typical fuel cycle system and economic analysis is presented. One 300 MW beam (300 ma-1 GeV) linear accelerator fuel regenerator can provide fuel for three 1000 MW(e) LWR power reactors over its 30-year lifetime. There is a significant saving in natural uranium requirement which is a factor of 4.5 over the present LWR fuel requirement assuming the restraint of no fissile fuel recovery by reprocessing. A modest increase (approximately 10%) in fuel cycle and power production cost is incurred over the present LWR fuel cycle cost. The linear accelerator fuel regenerator and producer assures a long-term supply of fuel for the LWR power economy even with the restraint of the non-proliferation policy of no reprocessing. It can also supply hot-denatured thorium U-233 fuel operating in a secured reprocessing fuel center.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 38225, 38258, 38297, 38298

38226 (ORNL/TM—6665) **Calorimetric assay of HTGR fuel samples.** Allen, E.J.; McNeany, S.R.; Jenkins, J.D. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

A calorimeter using a neutron source was designed and fabricated by Mound Laboratory, according to ORNL specifications. A calibration curve of the device for HTGR standard fuel rods was experimentally determined. The precision of a single measurement at the 95% confidence level was estimated to be +-0.8 μW. For a fuel sample containing 0.3 g ^{235}U and a neutron source containing 691 μg ^{252}Cf, this represents a relative standard deviation of 0.5%. Measurement time was approximately 5.5 h per sample. Use of the calorimeter is limited by its relatively poor precision, long measurement time, manual sample changing, sensitivity to room environment, and possibility of accumulated dust blocking water flow through the calorimeter. The calorimeter could be redesigned to resolve most of these difficulties, but not without significant development work.

38227 (ORNL/TM—6746) **Sol-gel sphere-pac activities for the fuel refabrication and development program. Quarterly progress report for period ending December 31, 1977.** Lotts, A.L.; Beatty, R.L. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

Development of the sol-gel sphere-pac process for remote refabrication of highly-gamma-active fuels was assigned to ORNL. Activities at ORNL have been subdivided into seven work areas or subtasks: sol-gel sphere-pac fuel technology status and performance assessment, sol preparation, sphere forming, washing and drying, sintering, fuel rod loading, and fuel rod inspection. Progress in each subtask is reported.

38228 (WCAP—9104) **Application of advanced accountability concepts in mixed oxide fabrication.** Bastin, J.J.; Dazen, J.R.; Jump, M.J.; Kapo, P.S.; Lange, R.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Nov 1977. Contract EY-77-C-09-0945-001. 167p. Dep. NTIS, PC A08/MF A01.

The report covers Phase I of a study of the application of DYMAC (DYnamic MAterial Control) concepts to use in a commercial mixed oxide facility, through evaluation of the concepts in a pilot facility (the Westinghouse Plutonium Fuels Development Laboratory). Phase I develops the basic test program (Phase II) and presents criteria for equipment and data scale-up, including information necessary to project the cost and schedule of Phase II. The total evaluation is designed to include analyses of measurement uncertainties, inventory trends, and other nuclear material balance fluctuations which have an effect on the detection of any plutonium removed, diverted, or unaccounted for in the process.

38229 (WCAP—9104(Add.1)) **Impact of receipt of coprocessed uranium/plutonium on advanced accountability concepts and fabrication facilities. Addendum 1 to application of advanced accountability concepts in mixed oxide fabrication.** Bastin, J.J.; Jump, M.J.; Lange, R.A.; Randall, C.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Nov 1977. Contract EY-77-C-09-0945-001. 59p. Dep. NTIS, PC A04/MF A01.

The Phase I study of the application of advanced accountability methods (DYMAC) in a uranium/plutonium mixed oxide facility was extended to assess the effect of coprocessed UO_2—PuO_2 feed on the observations made in the original Phase I effort and on the proposed Phase II program. The retention of plutonium mixed with uranium throughout the process was also considered. This addendum reports that coprocessed feed would have minimal effect on the DYMAC program, except in the areas of material specifications, starting material delivery schedule, and labor requirements. Each of these areas is addressed, as are the impact of coprocessed feed at a large fuel fabrication facility and the changes needed in the dirty scrap recovery process to maintain the lower plutonium levels which may be required by future nonproliferation philosophy. An amended schedule for Phase II is included.

38230 (WCAP—9104(Add.2)) **Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication.** Bastin, J.J.; Jump, M.J.; Lange, R.A.; Crandall, C.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Nov 1977. Contract EY-77-C-09-0945-001. 35p. Dep. NTIS, PC A03/MF A01.

The Phase I study of the application of advanced accountability methods (DYMAC) in a uranium/plutonium mixed oxide facility was extended to cover the possible fabrication of uranium-233/thorium fuels. Revisions to Phase II of the DYMAC plan which would be necessitated by such a process are specified. These revisions include shielding requirements, measurement systems, licensing conditions, and safeguards considerations. The impact of the uranium/thorium cycle on a large-scale fuel fabrication facility was also reviewed; it was concluded that the essentially higher radioactivity of uranium/thorium feeds would lead to increased difficulties which tend to preclude early commercial application of the process. An amended schedule for Phase II is included.

38231 (WCAP—9104(Add.3)) **Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication.** Zawoyski, F.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Nov 1977. Contract EY-77-C-09-0945-004. 82p. Dep. NTIS, PC A05/MF A01.

The Phase I study of the application of advanced accountability methods (DYMAC) in a uranium/plutonium mixed oxide facility was extended to include an implementation plan for the Automatic Data Processing System, as required by ERDA Manual Appendix 1830. The proposed system consists of a dual-control computer system with a minimum complement of peripheral equipment, which will be interfaced to the necessary measuring and display devices. Technical specifications for hardware and software system requirements are included, and cost estimates based on these specifications have been obtained.

38232 (WCAP—9144) **Review of waste management for a large-scale mixed oxide fuel fabrication facility.** Olson, R.E.; Goodman, J.; Gilchrist, M.C. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)). Sep 1977. Contract EY-77-C-09-0945-007. 45p. Dep. NTIS, PC A03/MF A01.

The points of origin and types of transuranic and low-level wastes to be expected from a large-scale mixed oxide fuel fabrication facility have been defined. Estimates of quantities by source and type are also made, and plans for disposition detailed. Shipping and disposal costs are predicted, insofar as parameters are known at present.

38233 (WCAP—9189) **State-of-the-art survey of pneumatic powder transport.** Skriba, M.C.; Wu, C.K.; Yang, W.C. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)). Aug 1977. Contract EN-77-C-06-1058-001. 85p. Dep. NTIS, PC A05/MF A01.

Prior to design and installation of a test loop for study of pneumatic transport of nuclear fuel fine powders, a survey was made of the present state of the art. The survey included an extensive literature review, a study of available hardware, and an appraisal of the operating experience of nuclear users of existing pneumatic systems. The scope was limited to dilute phase transport to conform to process, maintenance, and safety requirements. Pneumatic transfer of nuclear fuel fine powders was found to be technologically viable, and a program of pilot-scale tests is recommended to establish design criteria and equipment specifications.

38234 (WCAP—9200) **Waste management state-of-the-art review for mixed-oxide fuel fabrication facilities.** Woodsum, H.C.; Goodman, J. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)). Nov 1977. Contract EN-77-C-06-1085-001. 90p. Dep. NTIS, PC A05/MF A01.

This report provides a state-of-the-art review of the waste management for mixed-oxide (MOX) fuel fabrication facilities. The intent of this report is to focus on those processes and regulatory issues which have a direct bearing on existing and anticipated future management of transuranic (TRU) wastes from a commercial MOX fuel fabrication faciity. Recent government agency actions are reviewed with regard to their impact on existing and projected waste management regulations; and it is concluded that acceleration in the development of regulations, standards, and criteria is one of the most important factors in the implementation of improved MOX plant waste management techniques. ERDA development programs pertaining to the management of TRU wastes have been reviewed and many promising methods for volume reduction of both solid and liquid wastes are discussed. For solid wastes, these methods include compaction, shredding and baling, combustion, acid digestion, and decontamination by electropolishing or by electrolytic treatment. For liquid wastes, treatment options include evaporation, drying, calcination, flocculation, ion exchange, filtration, reverse osmosis, combustion (of combustible organics), and bioprocessing. Based on this review, it is recommended that ERDA continue with its combustible solid waste volume reduction program and complete these development activities by 1979. Following this, a critical evaluation of solid waste volume reduction techniques should be made to select the most promising systems for a commercial MOX fuel facility.

38235 (WCAP—9278) **Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility.** Woodsum, H.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Mar 1978. Contract EN-77-C-06-1058-001. 120p. Dep. NTIS, PC A06/MF A01.

Metal surface-powder adherence tests showed that the average mean values for direct impingement was 60 to 80 g/ft², whereas the average mean values of the colloidal samples were 0.2 to 2.5 g/ft². Thus, it is advantageous to design powder processing equipment to reduce direct impingement wherever possible. Holdup of powder appears to be relatively independent of the surface material or finish, and it is reduced significantly by low-frequency vibration of the surface. Under colloidal conditions, ThO_2 produces more residual material than UO_2 and is preferentially deposited from a UO_2—ThO_2 blend. Pure ThO_2 and high enrichment blends of ThO_2 in UO_2 are expected to produce a significant, persistent electrostatic charge, thus increasing residual holdup. Residual holdup in the clean scrap recovery system (CSRS) could be reduced by 25%. Comparison of CSRS holdup and powder adherence-metal surface data indicated that the areal density of residual material (40 g/ft²) was considerably higher than for colloidal suspension (<2.5 g/ft²). Steady-state residual holdup factor for sintered-metal filters was 13 g/ft² of filter surface area under optimum conditions. During the pellet grinding tests, residual material built up in the system at rate of about 100 g/h to an estimated limit of 1.4 kg, primarily within the particle collector shroud. During dry grinding, 97% of this residue was contained within the shroud, and during wet grinding only 50% was contained in the shroud owing to inertial effects of the rotating wheel and water coolant.

38236 (WCAP—9282) **State of the art survey and measurements of releases within confinement structures from MOX fuel fabrication components.** Woodson, H.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Mar 1978. Contract EN-77-C-06-1058-001. 89p. Dep. NTIS, PC A05/MF A01.

Processes most likely to produce significant releases within the confinement in MOX fuel fabrication facilities were identified to be pellet crushing and clean scrap recovery, and pellet grinding. Powder releases from normal operations of pellet grinding and crushing, the first step in the Clean Scrap Recovery System (CSRS), and a simulated accidental release due to a pneumatic transfer line leak in the CSRS were investigated. Results confirm that only a very

small fraction of powder released within a containment would reach the external environment. (DLC)

38237 (WCAP—9293) **Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for the period ending December 31, 1977.** Limpert, J.C. (comp.). (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). 1977. Contract EN-77-C-06-1058-001. 42p. Dep. NTIS, PC A03/MF A01.

The staus of the following five tasks is reported: application of advanced accountability concepts in mixed oxide fuel fabrication; pneumatic powder transport system development; power batch weighing system; residual material holdup and powder release; and barrier seal development. Three studies related to nondestructive analysis instrumentation for DYMAC application were begun. Procurement of the transport loop components and test materials has been completed. All major components have been received and test facility modification for the transport loop installation has been accomplished. The loop construction is continuing; the installation of power processing vessels, loop piping, and line elements, as well as the control panel, is 85-percent complete. The test material, 300 kg of ThO_2 powder (purchased from Rhodia), has been received and physically characterized; it meets the procurement specification. An assessment of the impact of substituting a coprocessed uranium—plutonium mixture containing from 10 to 30 percent plutonium for the pure PuO_2 component of the powder batching system has been completed. It was concluded that no significant technical, vendor delivery, or schedule problems would result. An evaluation of system configuration problems (equipment stackup) generated by the proposed change to coprocessed feed material was initiated to determine the compatibility of the design change with the mixed oxide plant design and configuration. The experimental program for measuring residuals and releases has been completed. Two reports on the experimental work related to residual material holdup and powder releases were drafted during this period. The barrier seal program work scope was adjusted after the third quarter to reflect the necessary program change to a custom-design development project.

38238 (WCAP—9422) **Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for period ending September 30, 1978.** Limpert, J.C. (comp.). (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). 1978. Contract EN-77-C-06-1058-001. 88p. Dep. NTIS, PC A05/MF A01.

In the pneumatic powder transport system development task, the coprecipitated master mix, UO_2—ThO_2, was blended and analyzed, both chemically and physically. Fabrication and assembly of the three-component (MO_2, UO_2, and COMOX) powder batch weighing system was completed by Toledo Scale Company, and the system shakedown and functional checkout were conducted at their plant. The functional checkout confirmed that the system was operational and met specified functional requirements for powder flow rate, weighing accuracy and precision, residual material holdup, computer process control, remote operation, and semiremote maintenance. Portland Cement was used as a surrogate powder for UO_2 for the functional checkout because of its similar flow characteristics. No significant problems were observed during the functional checkout. Weighing accuracy and precision were determined from repeated application of standard calibration weights. The measurement error was less than 50 percent of the specified maximum of 0.1 percent of the applied load. Powder flow through each of the system's subsystems exceeded the minimum allowable flow. The system operated in the manual, semi-automatic, and automatic modes and all controls and alarms remained functional. Residual holdup levels were within the limits specified. The system has been disassembled and packaged, and is currently in transit to Westinghouse Cheswick, Pennsylvania, where a detailed evaluation of it will be made using UO_2 powder as the batch feed material. The barrier seal was installed in a test system and a cold test program was conducted to evaluate the seal's performance.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 38233, 38251, 38252, 39253

38239 (LA—7645-MS) **Passive neutron assay of irradiated nuclear fuels.** Hsue, S.T.; Stewart, J.E.; Kaieda, K.; Halbig, J.K.; Phillips, J.R.; Lee, D.M.; Hatcher, C.R. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 22p. Dep. NTIS, PC A02/MF A01.

Passive neutron assay of irradiated nuclear fuel has been investigated by calculations and experiments as a simple, complementary technique to the gamma assay. From the calculations it was found that the neutron emission arises mainly from the curium isotopes, the neutrons exhibit very good penetrability of the assemblies, and the neutron multiplication is not affected by the burnup. From the experiments on BWR and PWR assemblies, the neutron emission rate is proportional to burnup raised to 3.4 power. The investigations indicate that the passive neutron assay is a simple and useful technique to determine the consistency of burnups between assemblies.

38240 (ORNL/TM—6672) **Removal of organic material from recycle nitric acid by ozone.** Clark, W.E.; Howerton, W.B. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 27p. TIC.

Organic compounds can be removed from recycle nitric acid (e.g., 2.5 to 10 M HNO_3) by ozonation. In the absence of catalysts the removal of acetic acid, one of the most resistant of the aliphatic species, was found to be slower than its removal from distilled water under similar conditions. At 95°C, about 8 h was required to reduce the carbon content of a 10 M HNO_3 solution from 100 to 10 $\mu g/ml$ in the absence of catalysts. However, the same reduction was accomplished in only about 1 h when silver ion was added at a concentration of 50 mg/liter. Silver ion (Ag^+) is the nmost effective of the catalysts tested for removal of acetic acid from 2.5 to 10 M HNO_3 by ozonation. Other, less efficient, catalysts include Pd^{2+}, Mn^{2+}, Fe^{3+}, and silica gel. The initial stages of the reaction in nitric acid appear to be first order with respect to the acetic acid conentration when no catalyst is present. Average rate constants are $1.75 \times 10^{-5}\ s^{-1}$ at 75°C, $4.50 \times 10^{-5}\ s^{-1}$ at 85°C, and 1.02×10^{-4} s at 95°C. The pseudo activaion energy calculated from an Arrhenius plot of these data is about 27 kcal/mole.

38241 (RFP—2886) **Americium recovery and purification at Rocky Flats.** Navratil, J.D.; Martella, L.L.; Thompson, G.H. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 28p. (CONF-790415—30). Dep. NTIS, PC A03/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

Portions of document are illegible.

Americium processing at Rocky Flats Plant is described. The americium is recovered from plutonium metal by a pyrochemical process; the resulting molten salt extraction residues must be processed to recover americium. At present the process uses cation exchange with Dowex 50W-X8 resin, This work shows that a macroporous resin, BioRad AG MP-50, has 30 to 50% more capacity and better elution kinetics than Dowex 50W-X8. Two extraction methods, solvent extraction and extraction chromatography with an organophoshorus bidentate, are also described. Americium is effectively decontaminated from magnesium and aluminum, and recovered by these methods.

38242 (RFP—2887) **Pyrochemical coprocessing of UO_2—PuO_2 LMFBR fuel by the Salt Transport Method.** Knighton, J.B.; Baldwin, C.E. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 24p. (CONF-790415—29). Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

The pyrochemical coprocessing of spent nuclear fuel by the Salt Transport Process appears to be a potentially viable reprocessing method, not only as an "exportable proliferation resistant technology," but as a domestic reprocessing operation. All operations are nonaqueous and waste generation is in solid form, thus requiring no conversion from aqueous solutions to solids.

38243 (IDO—1540-T1) **Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report.** (Energy, Inc., Idaho Falls, ID (USA)). [nd]. Contract EY-76-C-07-1540. 77p. Dep. NTIS, PC A05/MF A01.

This document provides a draft of the Reference Facility Descriptions of the Radioactive Gaseous Waste Collection and treatment processes of a Fuel Reprocessing Plant. The basis for the proposed facility design is a 2000-metric ton heavy metal per year fuel reprocessing plant, considering only a light water reactor fuel cycle. This document discusses reference processes for the retention and treatment of iodine, carbon-14, and krypton. The four principal Chapters are: (I) Introduction, (II) Reference Facility Descriptions and Design Basis, and (III) Environmental Impact Assessment of the Reference Facilities. The technical basis for the Reference Facility designs is considered available technology.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 39260, 39277, 39278, 39279

38244 (NUREG/CR—0558) **Study of the mechanics of a transportation accident involving natural uranium concentrate. Final report, June 8, 1978—September 8, 1978.** Colton, J.D.; Emerson, R.E. (SRI

International, Menlo Park, CA (USA). Poultry Lab.). Oct 1978. 66p. (SRI—7406-4). NTIS, PC A05/MF A01.

An investigation was made of several damaged Rule 40 55-gallon drums that spilled natural uranium concentrate as the result of a truck accident. Spillage occurred when the drums were deformed such that the drum lids separated from the drums. It was concluded that this deformation was produced by quasi-static crush loading while the drums were still inside the truck. Laboratory tests that simulate this quasi-static crush loading were conducted on standard and modified drums. In terms of the crush force required to create an opening between the drum and lid, there was little difference between a standard Rule 40 drum and a standard 17C drum. However a Rule 40 drum with a stiffened lid required almost twice the crush force to produce closure failure. The crush force to continue the deformation and increase the opening was greater for the 17C drum than for the standard Rule 40 drum, and it was greatest for the Rule 40 drum with the stiffened lid. It was found that drum integrity could be significantly improved by placing a neoprene bladder over the open end of the drum before the lid was attached. When the drum is crushed, the bladder covers the opening created between the drum and lid, thus preventing spillage of the contents of the drum. 32 figures, 2 tables.

38245 (NUREG/CR—0756) **Transportation of radioactive material in Illinois: June 6, 1977—June 6, 1978.** (Illinois Dept. of Public Health, Springfield (USA). Div. of Radiological Health). Mar 1979. 26p. NTIS, PC A03/MF A01.

Surveillance personnel were located at nine districts throughout the State near major interstate highways. Ten troopers were supplied with surveillance instrumentation. During the period, 51 stops were made by the state troopers. Four warnings were issued; three were for improper placarding and one for overloading. Radioactivity levels in the cab areas of the vehicles and on the outside surfaces were monitored. Results show that most vehicles surveyed have radiation levels below DOT levels, but that other DOT regulations are not always being followed. Recommendations are given for improving the efficiency and effectiveness of the transportation study. (DLC)

38246 (PNL—2457) **Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle.** Lippek, H.E.; Schuller, C.R. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 188p. Dep. NTIS, PC A09/MF A01.

A study was conducted to identify major legal and institutional problems and issues in the transportation of spent fuel and associated processing wastes at the back end of the LWR nuclear fuel cycle. (Most of the discussion centers on the transportation of spent fuel, since this activity will involve virtually all of the legal and institutional problems likely to be encountered in moving waste materials, as well.) Actions or approaches that might be pursued to resolve the problems identified in the analysis are suggested. Two scenarios for the industrial-scale transportation of spent fuel and radioactive wastes, taken together, high-light most of the major problems and issues of a legal and institutional nature that are likely to arise: (1) utilizing the Allied General Nuclear Services (AGNS) facility at Barnwell, SC, as a temporary storage facility for spent fuel; and (2) utilizing AGNS for full-scale commercial reprocessing of spent LWR fuel.

38247 (RHO-CD—271) **Spent unreprocessed fuel (SURF) facility evaluation plan of the alternative storage concepts.** Berry, S.M. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). 9 Feb 1978. Contract EY-77-C-06-1030. 37p. Dep. NTIS, PC A03/MF A01.

Concepts were evaluated for the storage of unreprocessed spent fuel in a retrievable surface storage facility. This document provides a systematic format for making a concept selection from the seven alternative concepts presented in RHO-LD-2. Results of the evaluation was that the Drywell concept was rated highest with the Water Basin Concept and the Sealed Storage Cask concept with multiple canisters of SURF coming in a close second and third. (DLC)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 38232, 38234, 38300

38248 (CONF-790602—30) **Evaluations of alternatives for management of INEL transuranic waste.** Smith, T.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The results of studies to identify and evaluate alternatives for long-term management of transuranic-contaminated waste at the Idaho National Engineering Laboratory are discussed. Three processing approaches have been studied: incineration; compaction and immobilization; and repackaging only. Four locations and four methods have been identified for possible onsite disposal of retrieved waste.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 38243, 39049

38249 (CONF-790331—4) **Solid waste handling and decontamination facility.** Lampton, R.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From Waste management seminar; Oak Ridge, TN, USA (6 Mar 1979).

The Title 1 design of the decontamination part of the SWH and D facility is underway. Design criteria are listed. A flowsheet is given of the solid waste reduction. The incinerator scrubber is described. Design features of the Gunite Tank Sludge Removal and a schematic of the sluicer, TV camera, and recirculating system are given. 9 figures. (DLC)

38250 (CONF-790420—9) **Processes for immobilization of high-level solid wastes by glass and ceramic matrices.** Lin, K.H.; Clark, W.E.; Howerton, W.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From International symposium on ceramics in nuclear waste management; Cincinnati, OH, USA (30 Apr 1979).

Processes for immobilization of waste SiC hulls and fissile particles from reprocessing of HTGR fuels are presented. Compressed cylinders of waste-matrix material were formed under ~ 35, 71, or 142 MPa and sintered at ~ 500 to 1025°C for ~ 1 hour. The cylinders containing 50% SiC-25% soft glass-25% red clay possess the most desirable properties (high mechanical strength, low surface area and low leachability) of several different compositions studies. Within the pressure range studied, the pressure of cylinder formation does not appear to have any significant effect on those properties. 5 tables.

38251 (IAEA—209) **Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976.** (International Atomic Energy Agency, Vienna (Austria)). 1978. 70p. Dep. NTIS (US Sales Only), PC A05/MF A01.

Radioisotopes in the gaseous effluents arising from fuel reprocessing plants are examined and the state of the art to remove, store and dispose of them are discussed. The generation and discharge of krypton-85, iodine-129, tritium and carbon-14 are treated in details. A comparison of the various separation processes is made. Economic aspects of removal of the radionuclides are analysed.

38252 (MLM—2595) **Adsorption of neptunium and plutonium on metal phosphites.** Silver, G.L. (Mound Facility, Miamisburg, OH (USA)). 16 Apr 1979. Contract AC04-76DP00053. 44p. Dep. NTIS, PC A03/MF A01.

The removal of neptunium and plutonium from water by adsorption on titanium, zirconium, bismuth, thorium, and uranium phosphites was investigated. These phosphites hydrolyze in neutral or alkaline solution producing the hydrous metal oxides that are more effective adsorbents than the original phosphite compounds. Ageing the plutonium-238 polymer changes its adsorption characteristics on commercial bone char. 37 figures, 7 tables.

38253 (NUREG/CR—0724) **Study of reverse osmosis applicability to light water reactor radwaste processing.** Markind, J.; Van Tran, T. (Abcor, Inc., Wilmington, MA (USA). Walden Div.). Dec 1978. 144p. NTIS, PC A07@MF A01.

Objectives were to collect and evaluate documented performance data of existing reverse-osmosis/ultrafiltration processes utilized for treating low-level liquid radioactive wastes, originating from light-water-reactor (LWR) nuclear power plants. Relevant information was collected by communication both written and verbal with membrane experts known to be active in the nuclear industry, and by conducting manual and computer searches. The generated information was evaluated on the basis of membrane performance characteristics relevant to nuclear engineering system analysis. 39 figures, 34 tables.

38254 (ORNL/TM—6573) **Radioactive waste fixation in FUETAP (formed under elevated temperature and pressure) concretes-experimental program and initial results.** Moore, J.G.; Newman, E.; Rogers, G.C. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 24p. AT.

Studies are in progress that will determine the feasibility of concretes formed under elevated temperature and pressure (FUETAP) as hosts for radioactive wastes. These wastes, mixed with cementitious materials to fix the radionuclides, are allowed to solidify and cure at temperatures and pressures up to 300°C and 1000

psi. The radioactifve waste categories most amenable to this process and any advantages over existing concepts for the fixation of high specific-activity wastes will be established. Technological studies will examine the thermal, radiological, and physical properties of FUETAP concretes as a function of temperature, pressure, and composition. In addition, gas generation characteristics will be determined as a function of temperature and irradiation before and after removal of any evaporable water from the solids. A concurrent assessment of the acceptability of the waste form will be made by examining the durability, leachability, long-term gas generation characteristics, and the physical properties of the concrete product. Initial studies showed that reasonably hard, durable solids containing up to 15-wt % simulated radioactive sludge could be made by subjecting cementitious mixtures to 250°C and 600 psi for 24 h. Such solids exhibited extremely low plutonium leach rates and caused rapid recombination of hydrogen and oxygen at room temperature. 7 tables.

38255 (PNL—2690) **Conceptual design of a nuclear waste vitrification facility.** Larson, D.E.; Blair, H.T.; Bonner, W.F.; Garrett, A.A.; Hanson, M.S.; Romero, L.S.; Siemens, D.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 69p. Dep. NTIS, PC A04/MF A01.

This document describes a conceptual high-level waste immobilization facility. The facility would have the capability to calcine and then vitrify high-level liquid waste (HLLW). The vitrification would be accomplished in a canister which is seal-welded, checked for integrity, and decontaminated for movement to storage. Included in the facility would be the capability to repair faulty canister-lid seal welds, overpack failed canisters, and treat the process off-gas and cell ventilation air prior to release to the fuel reprocessing plant (FRP) atmospheric protection system (APS). The nuclear waste vitrification facility (NWVF) would be an integral part of the FRP structure. The operations of the facilities would be centered in the waste vitrification cell (WVC) which performs most of the facility functions. The cell is a reinforced concrete hot cell, lined with stainless steel. Most operation and maintenance activities would be performed remotely using a crane equipped with an impact wrench or yoke. The major facility equipment includes a feed tank, spray calciner, two melters, weld-inspection stations, canister storage rack, and a canister decontamination cubicle. Installation and removal of equipment in the cell would be done through shielding doors. The air lock system of the canister decontamination cubicle would permit placement and removal of the canister. Activities in the cell may be observed through four shielding glass windows and/or up to three periscopes. The operating, service, and pipe galleries which house operating personnel and equipment necessary for cell operations are located adjacent to the cell.

38256 (PNL—2809) **Physical modeling of joule heated ceramic glass melters for high level waste immobilization.** Quigley, M.S.; Kreid, D.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 159p. Dep. NTIS, PC A08/MF A01.

This study developed physical modeling techniques and apparatus suitable for experimental analysis of joule heated ceramic glass melters designed for immobilizing high level waste. The physical modeling experiments can give qualitative insight into the design and operation of prototype furnaces and, if properly verified with prototype data, the physical models could be used for quantitative analysis of specific furnaces. Based on evaluation of the results of this study, it is recommended that the following actions and investigations be undertaken: It was not shown that the isothermal boundary conditions imposed by this study established prototypic heat losses through the boundaries of the model. Prototype wall temperatures and heat fluxes should be measured to provide better verification of the accuracy of the physical model. The VECTRA computer code is a two-dimensional analytical model. Physical model runs which are isothermal in the Y direction should be made to provide two-dimensional data for more direct comparison to the VECTRA predictions. The ability of the physical model to accurately predict prototype operating conditions should be proven before the model can become a reliable design tool. This will require significantly more prototype operating and glass property data than were available at the time of this study. A complete set of measurements covering power input, heat balances, wall temperatures, glass temperatures, and glass properties should be attempted for at least one prototype run. The information could be used to verify both physical and analytical models. Particle settling and/or sludge buildup should be studied directly by observing the accumulation of the appropriate size and density particles during feeding in the physical model. New designs should be formulated and modeled to minimize the potential problems with melter operation identifed by this study.

38257 (RFP—2835) **Recovery of plutonium from insulation, scrap glass, and sand-slag residues.** Ziegler, D.L.; Garnett, J.E.; Fraser, J.K. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 12 Apr 1979. Contract EY-76-C-04-3533. 11p. Dep. NTIS, PC A02/MF A01.

Laboratory experiments were performed to evaluate methods for removing plutonium from insulation, glass leach heel, and sand and slag heel. The methods evaluated included hydrochloric acid leaching, nitric acid leaching, and a treatment consisting of a fusion step followed by acid leaching. Results indicate that a nitric acid leach is effective in lowering the plutonium concentration of these solid wastes to the desired limit, if multiple contacts are used. A hydrochloric acid leach was found to be superior to a nitric acid leach for removing plutonium from the residues.

38258 (SGAE—2875) **Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH.** Proksch, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jan 1978. 7p. (In German). (CH—225/78). Dep. NTIS (US Sales Only), PC A02/MF A01.

The research and development work carried out is described. It is highly practice-oriented and a large fraction of the capacity available is devoted to projects sponsored by or carried out in collaboration with industry. The main R and D areas are high-temperature gas-cooled reactor fuel, conditioning of radioactive wastes, radiation processing, and production of radioisotopes and labeled compounds.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 38251, 38283, 38284, 38285, 38286, 39707, 39726, 39727

38259 (AERE-R—8790) **Heat transfer aspects of underground disposal of radioactive waste.** Bourke, P.J. (UKAEA, Harwell. Atomic Energy Research Establishment). Dec 1977. 16p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Heat loss from blocks of vitrified waste buried in granite is described qualitatively and likely block and rock temperatures are roughly estimated. Interactions between the heat transfer and suggested engineering schemes for disposal are considered. The need for a more thorough analysis to determine whether or not maximum safe temperatures would be exceeded is discussed in relation to the overall management of the waste. The setting of different temperature limits for the bulk of the rock, for local hot spots and and for the waste is suggested to allow for safety criteria which will have to be specified and met. An experimental programme to provide data for confident quantitative prediction of the heat transfer is proposed.

38260 (CONF-790331—2) **Role of mathematical modeling in low-level radioactive waste management.** Ward, D.S.; Huff, D.D.; Eyman, L.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From Waste management seminar; Oak Ridge, TN, USA (6 Mar 1979).

With increased experience in shallow land burial of radioactive wastes, there is general recognition of the need for improved practices to reduce the release of radioactivity to the biosphere. One approach is to use mathematical models to gain insights into the impact of possible preventive and corrective engineering measures. Two deterministic models of hydrologic processes have been examined. On a watershed scale, a unified hydrologic model has been applied to the White Oak Creek Watershed in Oak Ridge, Tennessee. Comparison of predicted and observed streamflow at the basin outlet are favorable. The model has been applied to evaluate the consequences of a disposal area development, operation, and management; including clear-cutting of forested areas, installing near-surface infiltration-reduction seals, and surface water diversion channels. On a localized scale, a near-surface infiltration-reduction seal has been studied using a finite-element model for subsurface flow. The model has been used to calculate spatial moisture content and velocity distributions near the seal. Model results show how the path of infiltrating rainwater is altered. 7 figures.

38261 (CONF-790331—3) **Shallow land burial - why or why not.** Thompson, W.T.; Ledbetter, J.O.; Rohlich, G.A. (Texas Univ., Austin (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Waste management seminar; Oak Ridge, TN, USA (6 Mar 1979).

This paper summarizes a master's thesis on the state-of-the-art for shallow land burial of solid low-level radioactive wastes. The coverage of the thesis, which is condensed for this paper, ranges from site selection to problem case histories. Inherent in such coverage is the assessment of risk, the discussion of operational and management problems and the real significance of off-site migration. This topic is discussed in light of the stands taken that the migration is a serious problem and that it is not. Emphasis is on the engineering parameters of importance in site selection, and what pretreatment, if any, is needed.

38262 (CONF-790602—25) **Design and operation of a dry spent fuel storage installation.** Painter, M.J.; Meyer, H.S. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). 1979. Contract EY-76-C-07-1570. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The Idaho Chemical Processing Plant (ICPP) has received, stored, and reprocessed spent nuclear fuel for the last 25 years. The fuels originate from the reactor safety and testing programs at the Idaho National Engineering Laboratory (formerly the National Reactor Testing Station), Naval Reactors, Experimental Breeder Reactors, university and DOE test reactors, foreign test reactors, and other miscellaneous sources. Most fuels are stored in a conventional water basin. To handle certain new fuels for possible long-term storage prior to reprocessing, ICPP designed, built, and is operating two types of dry spent fuel storage installations.

38263 (N—78-31740) **Disposal of radioactive iodine in space.** Burns, R.E.; Defield, J.G. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Aug 1978. 40p. NTIS PC A03/MF A01.

The possibility of space disposal of iodine waste from nuclear power reactors is investigated. The space transportation system utilized relies upon the space shuttle, a liquid hydrogen/liquid oxygen orbit transfer vehicle, and a solid propellant final stage. The iodine is assumed to be in the form of either an iodide or an iodate, and calculations assume that the final destination is either solar orbit or solar system escape. It is concluded that space disposal of iodine is feasible.

38264 (NUREG/CR—0495(Vol.1)) **Information base for waste repository design. Volume 1. Borehole and shaft sealing.** Koplick, C.M.; Pentz,D.L.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 117p. (TR—1210-1(Vol.1)). NTIS, PC A06/MF A01.

This report discusses the design requirements and the current technology for sealing shafts and boreholes in an underground disposal facility for nuclear waste. The discussion is focused upon repositories for high-level waste disposal in bedded salt. The type of data necessary to evaluate a particular proposal for shaft or borehole sealing is presented.

38265 (NUREG/CR—0495(Vol.2)) **Information base for waste repository design. Volume 2. Equipment performance requirements.** Koplick, C.M.; Pentz,D.L.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 126p. (TR—1210-1(Vol.2)). NTIS, PC A07/MF A01.

This report describes equipment requirements for the operation of a nuclear waste repository. Only equipment which can significatnly affect nuclear safety was considered. A conceptual repository layout is presented and mining and ventilation methods are reviewed. Major emphasis is placed on nuclear waste handling operations, since these are peculiar to the situation at hand. A discussion of existing applicable regulations is also included.

38266 (NUREG/CR—0495(Vol.3)) **Information base for waste repository design. Volume 3. Waste/rock interactions.** Koplick, C.M.; Pentz, D.L.; Oston, S.G.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 128p. (TR—1210-1(Vol.3)). NTIS, PC A07/MF A01.

This report describes the important effects resulting from interaction between radioactive waste and the rock in a nuclear waste repository. The state of the art in predicting waste/rock interactions is summarized. Where possible, independent numerical calculations have been performed. Recommendations are made pointing out areas which require additional research.

38267 (NUREG/CR—0495(Vol.4)) **Information base for waste repository design. Volume .4 Mine structural features.** Byrne, R.J.; Koplick, C.M.; Oston, S.G.; Giuffre, M.S.; Myer, L.R.; Pentz, D.L. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 370p. (TR—1210-1(Vol.4)). NTIS, PC A16/MF A01.

This report discusses the mine structural features of an underground nuclear waste disposal facility which are important to repository operation, waste retrieval, and long-term waste containment. Emphasis is on repositories for high-level waste disposal in bedded salt, although much of the material is relevant to other geologic disposal mediums. The results of a numerical structural analysis of a depository in bedded salt are presented.

38268 (NUREG/CR—0495(Vol.5)) **Information base for waste repository design. Volume 5. Decommissioning of underground facilities.** Guiffre, M.S.; Plum, R.L.; Koplick, C.M.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 90p. (TR—1210-1(Vol.5)). NTIS, PC A05/MF A01.

This report discusses the requirements for decommissioning a deep underground facilitiy for the disposal of radioactive waste. The techniques for sealing the mined excavations are presented and an information base on potential backfill materials is provided. Possible requirements for monitoring the site are discussed. The performance requirements for backfill materials are outlined. The advantages and disadvantages of each sealing method are stated.

38269 (NUREG/CR—0495(Vol.6)) **Information base for waste repository design. Volume 6. Excavation technology.** Koplick, C.M.; Pentz, D.L.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 79p. (TR—1210-1(Vol.6)). NTIS, PC A05/MF A01.

This report discusses the excavation technology to be used for a nuclear waste facilitiy in a deep geologic formation. Particular emphasis is placed on the requirement to minimize the disturbance to the depository rock. This can reduce the probability of radionuclide migration through the rock surrounding the excavation. An information base is provided to assist in the evaluation of mining methods. A methodology is presented which can be used to determine performance requirements for excavation techniques.

38270 (NUREG/CR—0495(Vol.7)) **Information base for waste repository design. Volume 7. Executive summary.** Bartlett, J.W.; Koplick, C.M. (Analytic Sciences Corp., Reading, MA (USA)). Jan 1979. 22p. (TR—1210-1(Vol.7)). NTIS, PC A03/MF A01.

This report is an executive summary of studies in support of design performance criteria for radioactive waste repositories. Details of the study are provided in six companion volumes. The work developed information bases concerning shaft and borehole sealing, equipment performance requirements, waste/rock interactions, mine structural features, decommissioning performance, and excavation technology requirements. Results are summarized here under four headings: factors that are currently adequate, technology needing further development, critical information needs, and prudent repository operating procedures. Design option studies that are needed and the interactions between repository design and overall waste management strategy are also discussed.

38271 (PNL—1948) **Radioactivity associated with biota and soils of the 216-A-24 Crib.** Klepper, E.L.; Rogers, L.E.; Hedlund, J.D.; Schreckhise, R.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 62p. Dep. NTIS, PC A04/MF A01.

The 216-A-24 Crib was used from 1958 to 1966 to receive condensate (^{137}Cs, ^{90}Sr) from the 241-A and 241-AX Tank Farms. In 1975, rabbitbrush plants (Chrysothamnus nauseosus) growing on the crib were found to contain radioactive materials. Highest levels of activity and densest stands of rabbitbrush plants were in the center of the second section of the crib where a Geiger—Mueller count rate meter showed surface exposure rates of certain plants to be as high as 125 times background. Of the 519 shrubs on the second section, 364 were at background, 62 were up to 10 times background, and 93 were over 10 times background. Contaminated shrubs were restricted to the center of the crib; all shrubs more than 6 meters away from the centerline were at background levels. The shrubs appeared to absorb ^{137}Cs and trace amounts of other fission products from within or below the gravel layers. The gravel appeared to retain significant amounts of ^{137}Cs. Soil above the gravel layers was not contaminated. Cesium-137 was detectable in the upper cm of soil and in the litter, especially beneath canopies of plants with high levels of ^{137}Cs in their leaves. Some animal samples collected on the crib contained ^{137}Cs. Insect species associated with a rabbitbrush shrub containing ^{137}Cs and its litter showed higher levels of ^{137}Cs than other wider-ranging species caught in pitfall traps and by hand. Two out of seven pocket mice contained detectable amounts of ^{137}Cs with 70% of the total body burden in the muscle and skeleton. Recommendations for restoration of the crib surface include eradication of rabbitbrush plants, removal of the surface centimeter of soil on the central 12 meters of the crib, removal of the cobble layer from the surface, installation of a one-foot layer of clean soil and revegetation of the surface with cheatgrass. 12 figures, 14 tables.

38272 (RHO-BWI—79-100-1Q) **Basalt waste isolation program. Quarterly report, October 1—December 31, 1978.** Deju, R.A. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jan 1979. Contract EY-77-C-06-1030. 51p. Dep. NTIS, PC A04/MF A01.

In the Geosciences, Hydrology, and Engineered Barriers areas, work continued on schedule aimed at being able to make a site selection decision in 1981, as scheduled. Emphasis continued to be placed on geologic mapping studies, on hydrologic data gathering, and on definitions of waste/basalt interactions and needed engineered barriers. Construction of the Near-Surface Test Facility at the end of the quarter was approximately eight to ten weeks behind schedule. A number of problems affected the subcontractor's rate of advancement in the tunnels. Through design changes, this rate of advancement had improved to the initially planned rates by the end of the quarter. In the Engineering Testing area, design work, test planning, and fabrication of heaters and auxiliary equipment continued on schedule. In the Repository area, an Architect/Engineer

Evaluation Board was formally designated by the U.S. Department of Energy-Headquarters during October 1978. The evaluation board will select an architect/engineer for repository conceptual design with an option for follow-on Title I, Title II, and Title III engineering services. Selection will be completed by October 1979. In addition, repository preconceptual design studies continued on schedule with emphasis on compilation of repository functional design criteria by July 1979.

38273 (UCID—18101) **Limitations to the use of two-dimensional thermal modeling of a nuclear waste repository.** Davis, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jan 1979. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

Thermal modeling of a nuclear waste repository is basic to most waste management predictive models. It is important that the modeling techniques accurately determine the time-dependent temperature distribution of the waste emplacement media. Recent modeling studies show that the time-dependent temperature distribution can be accurately modeled in the far-field using a 2-dimensional (2-D) planar numerical model; however, the near-field cannot be modeled accurately enough by either 2-D axisymmetric or 2-D planar numerical models for repositories in salt. The accuracy limits of 2-D modeling were defined by comparing results from 3-dimensional (3-D) TRUMP modeling with results from both 2-D axisymmetric and 2-D planar. Both TRUMP and ADINAT were employed as modeling tools. Two-dimensional results from the finite element code, ADINAT were compared with 2-D results from the finite difference code, TRUMP; they showed almost perfect correspondence in the far-field. This result adds substantially to confidence in future use of ADINAT and its companion stress code ADINA for thermal stress analysis. ADINAT was found to be somewhat sensitive to time step and mesh aspect ratio. 13 figures, 4 tables.

38274 (UCID—18103) **Convection and thermal radiation analytical models applicable to a nuclear waste repository room.** Davis, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jan 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

Time-dependent temperature distributions in a deep geologic nuclear waste repository have a direct impact on the physical integrity of the emplaced canisters and on the design of retrievability options. This report (1) identifies the thermodynamic properties and physical parameters of three convection regimes - forced, natural, and mixed; (2) defines the convection correlations applicable to calculating heat flow in a ventilated (forced-air) and in a nonventilated nuclear waste repository room; and (3) delineates a computer code that (a) computes and compares the floor-to-ceiling heat flow by convection and radiation, and (b) determines the nonlinear equivalent conductivity table for a repository room. (The tables permit the use of the ADINAT code to model surface-to-surface radiation and the TRUMP code to employ two different emissivity properties when modeling radiation exchange between the surface of two different materials.) The analysis shows that thermal radiation dominates heat flow modes in a nuclear waste repository room.

38275 (UCRL—50050-78) **Waste-isolation projects, FY 1978.** Ramspott, L.D. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

This report describes Lawrence Livermore Laboratory (LLL) activities during FY 1978 in support of the National Waste Terminal Storage Program. Current projects at LLL fall into three categories: (1) field testing, (2) laboratory rock mechanics measurements, and (3) laboratory studies of sorption and leaching. Field test activities conducted in the Climax granite at the Nevada Test Site included electrical heater tests, preparation for a spent-fuel-storage test, and planning for a series of rock mechanics tests. The heater tests determined the in situ thermal properties of Climax granite and its in situ permeability as a function of rock temperature. The two main laboratory rock mechanics projects involved (1) measurement of the permeability, electrical conductivity, and acoustic velocity of 15-cm-diam cores of granitic rocks over a range of confining pressure, pore (water) pressure, and deviatoric stress, and (2) measurement of rock thermal properties as a function of temperature and confining pressure in the presence of pore fluids to 770°K and 200 Mpa. The leaching studies made use of an LLL-designed, single-pass leaching apparatus with three solutions, two leach temperatures, and three flow rates. The material evaluated was Np—Pu-doped simulated waste glass from Battelle Pacific Northwest Laboratories. The sorption studies involved standard static measurements of the equilibrium distribution coefficient (K/sub d/) for various radionuclides on a variety of rocks, and flow-through-core studies of dynamic sorption.

38276 **United States program for the safety assessment of geologic disposal of commercial radioactive wastes.** Claiborne, H.C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). pp 199-215 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

The safe disposal of commercial radioactive wastes in deep geologic formations is the goal of the National Waste Terminal Storage (NWTS) Program. Safety assessment begins with selection of a disposal site; that is, all geologic and hydrologic factors must indicate long-term stability of the formation and prospective isolation of wastes from circulating ground waters for hundreds of thousands of years. The long-term stability of each site under thermal loading must then be demonstrated by sophisticated rock mechanic analyses. Therefore, it can be expected that the sites that are chosen will effectively isolate the waste for a very long period of time. However, to help provide answers on the mechanisms and consequences of an unlikely breach in the integrity of the repository, a Waste Isolation Safety Assessment Program (WISAP) is studied. The overall objective of this program is an assessment of the safety associated with the long-term disposal of high-level radioactive waste in a geologic formation. This objective will be achieved by developing methods and generating data necessary to characterize the safety of generic geological waste disposal concepts, which are to be applied in the assessment of specific sites. It is expected that no one particular model will suffice. Both deterministic and probabilistic approaches will be used, and the entire spectrum of phenomena that could influence geologic isolation will be considered.

38277 **Status report on research programmes of the Commission of European Communities related to risk evaluation of geological disposal of radioactive waste.** Girardi, F. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). pp 166-177 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

The programmes of the Commission of European Communities related to risk evaluation of geological disposal of radioactive waste are presented. The Joint Research Centre carries out theoretical modelling activities and a few selected experimental activities which are related to model development and verification. A set of contractual research activities, coordinated by the General Directorate of Research, Scientific Affairs and Education and set up primarily to encourage development of optimised waste management strategies will provide the many additional experimental data which are necessary for a realistic evaluation of long term hazard to man and the environment.

38278 **Status report for the United Kingdom.** Hill, M.D. (National Radiological Protection Board, Harwell (UK)); Mather, J.D. (Institute of Geological Sciences, London (UK)). pp 183-184 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

38279 **Status report on radioactive waste risk assessment methodology development supported by the U.S. Environmental Protection Agency.** Logan, S.E. (New Mexico Univ., Albuquerque (USA)). pp 178-179 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

38280 **Safety analysis of the proposed Canadian geologic nuclear waste repository.** Prowse, D.R. (Atomic Energy of Canada Ltd., Ottawa, Ontario). pp 185-198 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

The Canadian program for development and qualification of a geologic repository for emplacement of high-level and long-lived, alpha-emitting waste from irradiated nuclear fuel has been inititiated and is in its initial development stage. Fieldwork programs to locate candidate sites with suitable geological characteristics have begun. Laboratory studies and development of models for use in safety analysis of the emplaced nuclear waste have been initiated. The immediate objective is to complete a simplified safety analysis of a model geologic repository by mid-1978. This analysis will be progressively updated and will form part of an environmental Assessment Report of a Model Fuel Center which will be issued in mid-1979. The long-term objectives are to develop advanced safety

assessment models of a geologic repository which will be available by 1980.

38281 Estimating probabilities of disposal system failure - A status report. Tierney, M.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). pp 180-182 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

38282 Activities of the Nuclear Energy Agency Computer program library. Garcia de Viedma, L. (NEA Computer Program Library, Ispra (Italy)). pp 230-233 of Risk analysis and geologic modelling in relation to the disposal of radioactive wastes into geological formations. Paris, France; OCDE (1977).

From Workshop on risk analysis and geologic modelling; Ispra, Italy (23 May 1977).

In view of the increasingly important growth of the use of computers in nuclear energy, the Nuclear Energy Agency of the OECD established in 1964 the Computer Program Library (CPL), located at the Joint Research Centre, EURATOM, Ispra, Italy. The goals of this newly established Library were: to avoid unnecessary use of programming resources through excessive duplication of efforts by making existing programs more widely available; to improve communication between authors of computer programs and the users, thus furthering the efficient and economic use of the many large and expensive computers which these programs required. Sixteen countries actually participate in the work.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38260, 38271, 38599, 39583, 39601, 39613, 39619

38283 (DOE/EIS—0026-D(Vol.1)) **Draft environmental impact statement: Waste Isolation Pilot Plant.** (Department of Energy, Washington, DC (USA)). Apr 1979. vp. NEPA Coordination Office, Washington, DC.

This draft Environmental Impact Statement (EIS) has been prepared by the U.S. Department of Energy (DOE) in compliance with the National Environmental Policy Act (NEPA) to assess the environmental impacts of constructing and operating a proposed waste isolation pilot plant (WIPP) for the disposal of defense transuranic nuclear wastes (TRU), experimental research and development with high level waste forms and for the potential disposal of up to a thousand spent fuel assemblies in an intermediate scale facility (ISF). The WIPP would be licensed by the Nuclear Regulatory Commission (NRC) should project licensing be authorized by the Congress. The draft EIS is intended to serve as environmental input into future decisions concerning construction phases of the proposed repository, inclusion of the spent fuel option, timing and specific location of the facility, and land withdrawal in Eddy County, New Mexico, if that site is chosen. Analyses show that there are no significant radiological health impacts resulting from the alternatives considered, and that there are no clear environmental bases for choosing among alternatives other than the alternative of no action which is considered unacceptable in the long term. Seven alternatives are covered in the draft EIS including: no action, alternatives to TRU-waste disposal, alternatives for the intermediate-scale facility, alternative time schedules and potential alternative locations. The range of options was intended to cover a reasonable envelop within which governmental decisions can be made.

38284 (DOE/EIS—0026-D(Vol.2)) **Draft environmental impact statement: Waste Isolation Pilot Plant. Volume 2. Appendices.** (Department of Energy, Washington, DC (USA)). Apr 1979. vp. NEPA Coordination Office, Washington, DC.

This appendix contains reviews of each of the four candidate media (salt, crystalline rock, argillaceous rocks, and tuff) for disposal of transuranic and high-level wastes.

38285 (DOE/EIS—0046-D(Vol.1)) **Draft environmental impact statement: management of commercially generated radioactive waste.** (Department of Energy, Washington, DC (USA)). Apr 1979. vp. NEPA Coordination Office, Washington, DC.

This document describes ten alternative methods for disposal of nuclear wastes and evaluates their anticipated environmental impacts. The ten alternatives are: geologic disposal using conventional mining techniques, chemical resynthesis, very deep hole concept, rock melting concept, island disposal, sub-seabed geologic disposal, ice sheet disposal, reverse-well disposal, partitioning and transmutation, and space disposal. In evaluating the various technical strategies, issues and environmental impacts have been analyzed as best understood currently. Based on the analysis presented here, and in the light of the greater depth of knowledge on geologic disposal, the Department of Energy proposes that (1) the disposal of radioactive wastes in geologic formations can likely be developed and applied with minimal environmental consequences, and (2) therefore the program emphasis should be on the establishment of mined repositories as the operative disposal technology.

38286 (DOE/EIS—0046-D(Vol.2)) **Draft environmental impact statement: management of commercially generated radioactive waste. Volume 2. Appendices.** (Department of Energy, Washington, DC (USA)). Apr 1979. vp. NEPA Coordination Office, Washington, DC.

This volume contains the 20 appendices to the Environmental Impact Statement on the Management of Commercially Generated Waste (DOE—1559).

38287 (PB—285938) **Miscellaneous data and information collected during radiation surveys at the former Monument Uranium Mill site (1974—1975). Technical note.** Hans, J.M. Jr. (Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs). Jul 1978. 49p. NTIS PC A03/MF A01.

The purpose of the surveys was to delineate the spread and depth of ore and mill tailings in order that cost estimates could be made for their removal and interim stabilization of the tailings piles. The results of the surveys were prepared in summary form and very little data was made available. This report presents the data and information collected at the former Monument Uranium Mill site. The data includes gamma radiation background measurements, bore hole logging data, ground water analysis, gamma surveys, and radionuclide concentrations versus depth in soil. Interpretation of the data is made where possible. It appears, from bore hole logs, that a substantial amount of uranium is still present at the mill site.

38288 General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities. Fitoussi, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). pp 109-124 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978). (In French)

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

An explanation is given of the need to monitor the release of radioactive gases and liquid effluents from nuclear facilities, with particular emphasis on the ICRP recommendations and on the interest in this problem shown by the larger international organizations. This is followed by a description of the classes of radionuclides that are normally monitored in this way. The characteristics of monitoring 'in line' and 'by sample taking' are described; the disadvantages of in line monitoring and the problem of sample reapresentivity are discussed. There follows an account of the general principles for measuring gaseous and liquid effluents that are applied in the techniques normally employed at nuclear facilities. Standards relating to the specifications for monitoring instruments are at present being devised by the International Electrotechnical Commission, and there are still major differences in national practices, at least as far as measurement thresholds are concerned. In conclusion, it is shown that harmonization of practices and standardization of equipment would probably help to make international relations in the field more productive.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 38244, 38276, 38277, 38279, 38280, 38281, 39279, 39704

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 38228, 38229, 38230, 38231, 38235, 39275, 39276

38289 (CONF-790430—2) **Applying new safeguards technology to existing nuclear facilities.** Johnson, C.E.; Wagner, E.P. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

The application and operation of safeguards instrumentation in a facility containing special nuclear material is most successful when the installation is designed for the operation of the specific facility. Experience at the Idaho National Engineering Laboratory demonstrates that installation designs must consider both Safeguards

and Production requirements of specific facilities. Equipment selection and installation design influenced by the training and experience of production operations and safeguards personnel at a specific facility help assure successful installation, reliable operation, and minimal operator training. This minimizes impacts on existing plant production activities while maximizing utility of the safeguards information obtained.

38290 (K/OA—4488) **Minor isotope measurements for safeguarding a uranium enrichment plant.** Blumkin, S.; Levin, S.A.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 26 Mar 1979. Contract W-7405-ENG-26. 23p. (CONF-790430—1). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

A study of the behavior of the minor uranium isotopes in enrichment cascades indicates that the measurement of their concetrations in cascade feed and withdrawal streams can be used to confirm or deny material accountability results in safeguarding an enrichment plant. In further support of safeguard measures, an indirect non-intrusive method to measure cascade uranium inventory has been devised and tested satisfactorily in a gaseous diffusion cascade.

38291 (LA—7717-M) **Savannah River Plant Californium-252 Shuffler software manual.** Johnson, S.S.; Crane, T.W.; Eccleston, G.W. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 35p. Dep. NTIS, PC A03/MF A01.

A software manual for operating the Savannah River Plant Shuffler nondestructive assay instrument is presented. The procedures for starting up the instrument, making assays, calibrating, and checking the performance of the hardware units are described. A list of the error messages with an explanation of the circumstances prompting the message and possible corrective measures is given. A summary of the software package is included showing the names and contents of the files and subroutines. The procedure for modifying the software package is outlined.

38292 (MLM—2603) **Feasibility of a Mound-designed transportable calorimeter.** Duff, M.F.; Fellers, C.L. (Mound Facility, Miamisburg, OH (USA)). 16 Apr 1979. Contract AC04-76DP00053. 13p. Dep. NTIS, PC A02/MF A01.

The feasibility of operating a Mound twin resistance bridge calorimeter outside a temperature-controlled water bath was demonstrated. An existing calorimeter was retrofit with two additional jackets through which water was transferred from an external reservoir. Comparison of test results collected before and after the retrofit indicated that the calorimeter performance was not degraded by this modification. Similarly designed calorimeters have potential applications in laboratories where equipment space is limited for inspectors who are required to transport their assay instrumentation.

38293 (PB—286869) **Integrated safeguards information system (ISIS). Executive summary. Technical report.** Simonsen, R.H. (Boeing Computer Services Co., Falls Church, VA (USA)). Jun 1978. Contract NRC-04-77-065. 34p. NTIS PC A03/MF A01.

The Nuclear Regulatory Commission (NRC) regulates the nuclear power industry, including safeguarding nuclear materials against attack or sabotage. To assure that the needed information will be available, NRC has identified a need for initiating development of a comprehensive Integrated Safeguards Information System (ISIS) which will satisfy the requirements of NRC and integrate the collection, processing and dissemination of safeguards-related information. This information system must be developed to anticipate and meet safeguards information requirements into the mid-1980's and beyond. To initiate this development, a competitive contract was awarded to the Boeing Computer Services Company (BCS), in March 1977, to perform the first three phases of ISIS development. Phase I, defined the current and projected safeguards information needs of NRC. Phase II examined the capabilities of relevant existing and planned safeguards information systems within both the government and the licensed nuclear industry. Phase III developed a general design for ISIS.

38294 (SAND—78-0400) **Security seal handbook.** Poli, D.L. (Sandia Labs., Albuquerque, NM (USA)). Dec 1978. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

The handbook describes the security seal system philosophy, provides descriptions, evaluation information, installation guidelines, and verification instructions for available seals, and supplies information on the development of new seals. 25 figures, 3 tables.

38295 (SAND—79-0186) **Commercially available video motion detectors.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract AC04-76DP00789. 22p. Dep. NTIS, PC A02/MF A01.

A market survey of commercially available video motion detection systems was conducted by the Intrusion Detection Systems Technology Division of Sandia Laboratories. The information obtained from this survey is summarized in this report. The cutoff date for this information is May 1978. A list of commercially available video motion detection systems is appended.

38296 (WCAP—9128) **State-of-the-art survey of residual holdup in a 200 mt/yr MOX fuel fabrication facility.** Woodsum, H.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Nov 1977. Contract EY-77-C-09-0945-005. 39p. Dep. NTIS, PC A03/MF A01.

This survey is a state-of-the-art review of the processes leading to residual holdup in a large-scale (200 mt/yr) commercial mixed-oxide (MOX) fuel fabrication facility. It suggests areas where residual holdup could be reduced through redesign of components and recommmends experimental program requirements for reducing present uncertainties in holdup estimates. It provides an insight into what processes and components have the greatest potential for PuO_2 holdup and assesses the impact of this holdup relative to current special nuclear material (SNM) accountability requirements on limit of error in material unaccounted for (LEMUF). At the start of the survey, Westinghouse conducted a literature search to locate previously published estimates of residual holdup in large-scale commercial MOX fuel fabrication facilities. From this search, estimates of residual holdup from two recent reports by the Los Alamos Scientific Laboratory and Science Applications Incorporated (SAI) were selected for comparison with the Westinghouse estimates. Westinghouse then reviewed experimental data from Westinghouse-funded research and development programs for pneumatic transport, powder blending, and clean scrap recovery for its applicability to holdup in a full-scale MOX facility. From these data, residual holdup estimates were made for primary components in both runout and cleanout conditions. A comparison of the Westinghouse estimates with the selected estimates was made. The comparison showed relatively close agreement of estimates for after runout conditions but the LASL and SAI estimates were about 20 and 35 percent lower, respectively, than the Westinghouse estimates for after cleanout conditions. Differences were attributed primarily to discrepancies in front end processes.

38297 (WCAP—9344) **Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application.** Corbett, J.A.; Jump, M.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Dec 1977. Contract EN-77-C-06-1058-001. 42p. Dep. NTIS, PC A03/MF A01.

Because of renewed interest in the thorium-uranium fuel cycle, an evaluation of NDA systems applicable to DYMAC measurements in light water reactor (LWR) ^{233}U-Th fuel fabrication process was undertaken by Westinghouse. The purpose of this study is to summarize the information currently available on the nondestructive assay of thorium-uranium-233 oxide fuel materials and evaluate the applicability of the instrumentation for DYMAC measurements in a LWR fuel fabrication process. Based upon the data presented in this report, it appears that the NDA measurement system technology which was developed for ^{235}U fuel materials can be applied to LWR ^{233}U-Th fuels. Some modifications of detection systems for ^{233}U-Th measurements will be required to compensate for the high gamma activity background associated with ^{232}U daughter products. Additional instrument development and testing is recommended for ^{233}U-Th NDA measurement systems.

38298 (WCAP—9345) **Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation.** Limpert, J.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Dec 1977. Contract EN-77-C-06-1058-001. 29p. Dep. NTIS, PC A03/MF A01.

This study reviews the potential impact of fuel spiking to enhance proliferation resistance on (1) mixed-oxide fuel fabrication processes and (2) NDA instrumentation proposed for in-process material control, as well as demonstration programs to evaluate process and instrumentation performance. Based on data provided in a report by Brookhaven National Laboratory (BNL), a ^{60}Co spike of 10^{-1} Ci/kg of PuO_2, would be needed for mandatory operation in a fully remote mode. At 10^{-1} Ci/kg of PuO_2, high specific activity ^{60}Co has minimum impact on fuel performance. Fabrication operations, maintenance, and support services would have to be fully remote. However, hot-cell type construction would not be necessary. Such containment designs as proposed for the Westinghouse RFP, with an increased level of shielding, should be adequate. Further development of fully remote process and maintenance systems would be required. Material control in such processes is expected to be enhanced only by the complete isolation of material and personnel. The impact on current nondestructive assay (NDA) instrumentation is such that the range of applicable techniques is limited. At the specific spikant level examined, neutron detection instrumentation is expected to be functional, however, gamma assay techniques will be limited value. The assumption that neutron assay systems are not affected by moderate gamma fluxes is based on data not specifically developed for material control

measurements.Confirming studies should be performed prior to the initiation of any DYMAC test program. Based on positive results from such a program, a DYMAC test program could be conducted without the burden of having to process fuel with a spike added.

38299 (Y/DA—7999) **Microcomputer-based video motion detection system.** Howington, L.C. (Oak Ridge Y-12 Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 8p. (CONF-790502—4). Dep. NTIS, PC A02/MF A01.

From Caranahan conference on crime countermeasures; Lexington, KY, USA (6 May 1979).

This system was developed to enhance the volumetric intrusion detection capability of the Oak Ridge Y-12 Plant's security program. Not only does the system exhibit an extended range of detection over present infrared, microwave, and ultrasonic devices, it also provides an instantaneous assessment capability by providing the operator with a closed-circuit television (CCTV) image of the alarm scene as soon as motion is detected. The system consists of a custom-built, microcomputer-based, video processor which analyzes the signals received from a network of video cameras. The operator can view the camera images as they are displayed on a CCTV monitor while alarm scenes are displayed on a second monitor. Motion is detected by digitizing and comparing successive video frames and making an alarm decision based on the degree of mismatch. The software-based nature of the microcomputer lends a great deal of flexibility and adaptability in making the alarm decision. Alarm decision variables which are easily adjusted through software are the percent change in gray level required to label a pixel (picture element) as suspect, the number of suspect pixels required to generate an alarm, the pixel pattern to be sampled from the image, and the rate at which a new reference frame is taken. The system is currently being evaluated in a warehouse for potential application in several areas of the Plant. This paper discusses the hardware and software design of the system as well as problems encountered in its implementation and results obtained.

ADMINISTRATIVE AND REGULATORY

38300 (PB—284841) **Need for greater regulatory oversight of commercial low-level radioactive waste.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 16 Aug 1978. 23p. NTIS PC A02/MF A01.

Nuclear powerplant operations generate the greatest volumes of low-level radioactive wastes. Because of a lack of adequate burial space on the east coast, there is a need for Federal policy to encourage utilities to reduce waste volumes. Waste treatment systems installed in nuclear powerplants to handle low-level wastes have experienced operational difficulties resulting in increasing the potential for unnecessary exposures to nuclear powerplant workers and unplanned releases to the environment. GAO recommends that the Nuclear Regulatory Commission place greater emphasis on the licensing, inspection, and monitoring of low-level waste treatment systems and take actions aimed at reducing waste volumes.

FUSION FUELS

BY-PRODUCTS

38301 (BNL—25634) **Fusion reactors for synthetic fuels.** Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790602—39). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Some of the types of processes now being considered for synthetic fuels production from fusion energy, together with an example of each type are listed. The process efficiency is defined as the chemical energy in the generated hydrogen [at the higher heating value (HHV)] divided by the total fusion energy release, including alpha particles and secondary neutron reactions in the blanket. Except where specifically noted, both high and low temperature blanket heats are counted as part of total fusion energy release.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

REFER ALSO TO CITATION(S) 39288

RADIATION SOURCES

REFER ALSO TO CITATION(S) 39942

DESIGN AND FABRICATION

38302 (ORNL/TM—6660) **Compatibility of Pt-3008 with selected components of the selenide isotope generator system.** Keiser, J.R. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

The first in a new generation of radioisotopic thermoelectric generators being built by Teledyne Energy Systems and designated the Selenide Isotope Generator has thermoelectric materials that can be degraded by reaction with O_2, H_2O, CO, and other gases. Consequently, for at least the first ground demonstration system a protective xenon atmosphere will be maintained over the thermoelectrics. The high-temperature portion of the atmosphere-retaining structure will be fabricated from the alloy Pt-3008 (Pt—30 wt % Rh—8 wt % W), which was developed at Oak Ridge National Laboratory. For this application Pt-3008 must be compatible with the various insulations and thermoelectric materials. A study of the compatibility of Pt-3008 with these materials and showed that Pt-3008 was embrittled after exposure to some of the insulations that were not adequately outgassed and by one of the thermoelectric materials (Cu_2Se) in some of the isothermal tests. It is believed that Pt-3008 will be compatible with the Selenide Isotope Generator materials when they are well outgassed and under the temperature gradient conditions of the operating system.

38303 (PB—285117) **American national standard N433.1; safe design and use of self-contained, dry source storage gamma irradiators (Category I). Final report.** Eisenhower, E.H. (American National Standards Inst., New York). Jul 1978. 25p. NTIS PC A02/MF A01.

This standard applies to self-contained, dry source storage irradiators (Category I) that contain sealed gamma emitting sources for the irradiation of objects or materials. It establishes the criteria to be used in the proper design, fabrication, installation, use, and maintenance of these irradiators which will ensure a high degree of radiation safety at all times. The requirements of the standard are grouped as (1) general considerations, (2) manufacturer's responsibility, and (3) owner's responsibility. Included in the first group are general radiation protection criteria, sealed source performance requirements, and radiation survey needs. Among the manufacturer's responsibilities are criteria for maximum external radiation levels, integrity of shielding, and controls and indicators. The requirements for users include safety-related servicing, administrative procedures, operator qualifications, and routine safety tests.

OTHER INDUSTRIAL USES

38304 (KFK—2463) **Development of methods to measure the oil consumption of piston engines by means of radionuclide techniques.** Fritzsche, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Isotopentechnik; Karlsruhe Univ. (TH) (Germany, F.R.). Fakultaet fuer Maschinenbau). Mar 1978. 108p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

Thesis.

Selective oil consumption takes place when more low boiling fractions of a lubricating oil are consumed than higher boiling fractions. The influence of this oil consumption mechanism was examined for internal combustion engines and piston type air compressors. Two measuring systems were developed for cases where significant selective oil consumption is expected. Both employ Tritium labelled lubricating oil. The radiation from the Tritium in the oil consumed is detected in a gaseous or liquid phase. For cases where negligible selective oil consumption is expected another two measuring systems were developed. The first system uses oil labelled with radioactive ^{65}Zn. Oil consumed is adsorbed in an activated carbon filter, and the radiation from the ^{65}Zn in the filter is detected with a plastic scintillator detector. The second system uses normal Zn which is a regular component of lubricating oils for combustion engines. Oil consumed is again dasorbed in an activated carbon filter, but in this case the Zn is detected by X-ray fluorescence spectroscopy.

38305 (PB—284699) **Micro-isotope tool wear detector, phase I - Final report. Report for 1 October 1977—31 May 1978.** Hoagland, L.C.; Syniuta, W.D. (National Science Foundation, Washington, DC (USA)). 31 May 1978. 92p. NTIS PC A05/MF A01.

The results of a study to evaluate the feasibility of a Micro-Isotope Tool Wear Detection system as an industrial tool wear monitor, particulary for use with automated machining systems is presented. Lab tests had previously demonstrated the feasibility of reliable detection of extremely low radio isotope levels and demonstrated that a micro-isotope particle could be implanted within the wear zone of a metal cutting tool in such a way as to assure integrity until it is removed as part of the worn tool material. These specific

tasks were identified for this phase of the work as an initial step in evaluating industrial feasibility of the technique. The following tasks are described: (1) field evaluation; (2) universal implant fixture design; and (3) barriers to implementation. Industrial field tests were not completed because of production priority over testing, therefore more work is being planned before any firm conclusions regarding industrial feasibility can be drawn. An accurate, reliable, low cost field application isotope implantation technique appears feasible. The most significant potential barrier to implementation of the technique appears to be perceived need for an exemption from NRC user licensing requirements. Application for an exempt status is being pursued.

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 39106

DESIGN AND FABRICATION

38306 (N—78-28608) **Preliminary design study of an alternate heat source assembly for a Brayton isotope power system. Final report, October 1977—April 1978.** Strumpf, H.J. (AiResearch Mfg. Co., Torrance, CA (USA)). May 1978. Contract NAS3-20816. 112p. NTIS PC A06/MF A01.

Results are presented for a study of the preliminary design of an alternate heat source assembly (HSA) intended for use in the Brayton isotope power system (BIPS). The BIPS converts thermal energy emitted by a radioactive heat source into electrical energy by means of a closed Brayton cycle. A heat source heat exchanger configuration was selected and optimized. The design consists of a 10 turn helically wound Hastelloy X tube. Thermal analyses were performed for various operating conditions to ensure that post impact containment shell (PICS) temperatures remain within specified limits. These limits are essentially satisfied for all modes of operation except for the emergency cooling system for which the PICS temperatures are too high. Neon was found to be the best choice for a fill gas for auxiliary cooling system operation. Low cycle fatigue life, natural frequency, and dynamic loading requirements can be met with minor modifications to the existing HSA.

HYDROGEN

38307 (NTISUB/D—023) **Hydrogen energy: a bibliography with abstracts, 1978. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. vp. New Mexico Univ., Albuquerque.

The Hydrogen Energy Quarterly Update is a bibliographic series that contains citations and abstracts from over 7000 different sources devoted to hydrogen as a synthetic fuel or energy carrier. Foreign and domestic publications are cited, abstracted and indexed. The series provides current awareness to those interested in hydrogen energy. For easy reference, the Hydrogen Energy Quarterly is divided into five sections: general; production; utilization; transmission, distribution and storage; and safety. Author and permuted title/subject term indexes are included for easy access.

PRODUCTION

REFER ALSO TO CITATION(S) 38077, 38350

ELECTROLYSIS

REFER ALSO TO CITATION(S) 40005

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 38324

38308 (CONF-780161—1) **Solar energy conversion to hydrogen by algae and bacteria.** Mitsui, A. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1978. 46p. Univ. of Miami, FL.

From International conference on bioenergy; Zurich, Switzerland (12 Jan 1978).

This paper deals with various techniques for hydrogen production, with special consideration given to the use of solar radiation as the source of energy for the process. The biological approach to hydrogen production is emphasized. (LK)

38309 (SERI/TR—33-122) **Photobiological production of hydrogen: a solar energy conversion option.** Weaver, P.; Lien, S.; Seibert, M. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1979. Contract EG-77-C-01-4042. 109p. Dep. NTIS, PC A06/MF A01.

This literature survey of photobiological hydrogen production covers the period from its discovery in relatively pure cultures during the early 1930s to the present. The focus is hydrogen production by phototrophic organisms (and their components) which occurs at the expense of light energy and electron-donating substrates. The survey covers the major contributions in the area; however, in many cases, space has limited the degree of detail provided. Among the topics included is a brief historical overview of hydrogen metabolism in photosynthetic bacteria, eucaryotic algae, and cyanobacteria (blue—green algae). The primary enzyme systems, including hydrogenase and nitrogenase, are discussed along with the manner in which they are coupled to electron transport and the primary photochemistry of photosynthesis. A number of in vivo and in vitro photobiological hydrogen evolving schemes including photosynthetic bacterial, green algal, cyanobacterial, two-stage, and cell-free systems are examined in some detail. The remainder of the review discusses specific technical problem areas that currently limit the yield and duration of many of the systems and research that might lead to progress in these specific areas. The final section outlines, in broadest terms, future research directions necessary to develop practical photobiological hydrogen-producing systems. Both whole cell (near- to mid-term) and cell-free (long-term) systems should be emphasized. Photosynthetic bacteria currently show the most promise for near-term applied systems.

38310 **Recent developments in hydrogen production by microalgae.** Benemann, J.R.; Hallenbeck, P.C. (Univ. of Calfornia, Berkeley). pp 557-573 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).

Biophotolysis is the biological decomposition of water into hydrogen and oxyen. A number of different possible biological catalysts can be considered in biophotolysis. The ones based on cultures of algae and photosynthetic bacteria appear to be capable of bing developed into practical applications. The most near-term applications would be the development of a process for the photofermentation of wastes involving mixed heterotrophic and photosynthetic bacterial cultures. Such a system may be used with low nitrogen wastes and could be considered as an alternative to methane fermentations in some cases. Microalgae may be used in a more direct process of photosynthesis in which water is decomposed in single or two-stage systems. Two-stage systems would separate the hydrogen and oxygen production reactions and have the advantage of requiring only a relatively small area for collecting the hydrogen. Examples of two-stage systems involve the pumping and recycling of an angal culture from a shallow open pond to a deeper glass-covered pond. Alterntively, the hydrogen and oxygen reactions can alternate between night and day, respectively. The latter approach requires large glass-covered surfaces for collecting the hydrogen. The practical photosynthetic efficiency that may be achieved with well-controlled biophotolysis systems, of about 3%, limit the allowable capital investment, requiring very low-cost materials and designs. One design may involve long tubular, thin glass of 4 to 8 cm in diameter, as this material is very inexpensive. In one proposal, which has already been demonstrated under outdoor conditions, nitrogen-fixing blue—green algae are used to simultaneously produce hydrogen and oxygen. Many difficult biological and engineering problems remain and exploration of different approaches to biophotolysis will require extensive basic and applied research.

COAL GASIFICATION

REFER ALSO TO CITATION(S) 38074

PROPERTIES

38311 (N—78-30551) **Analysis of turbulent free jet hydrogen-air diffusion flames with finite chemical reaction rates. Final report.** Sislian, J.P. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Aug 1978. Contract NAS1-14843. 58p. NTIS PC A04/MF A01.

The nonequilibrium flow field resulting from the turbulent mixing and combustion of a supersonic axisymmetric hydrogen jet in a supersonic parallel coflowing air stream is analyzed. Effective turbulent transport properties are determined using the (K-epsilon) model. The finite-rate chemistry model considers eight reactions between six chemical species, H, O, H2O, OH, O2, and H2. The governing set of nonlinear partial differential equations is solved by an implicit finite-difference procedure. Radial distributions are obtained at two downstream locations of variables such as turbulent kinetic energy, turbulent dissipation rate, turbulent scale length, and

viscosity. The results show that these variables attain peak values at the axis of symmetry. Computed distributions of velocity, temperature, and mass fraction are also given. A direct analytical approach to account for the effect of species concentration fluctuations on the mean production rate of species (the phenomenon of unmixedness) is also presented. However, the use of the method does not seem justified in view of the excessive computer time required to solve the resulting system of equations.

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 38716

PROPERTIES

REFER ALSO TO CITATION(S) 39255

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 38047, 38055, 38064, 38070, 39222, 39246

38312 (LBL—8975, pp 8.-10.) **Auger and reaction studies of poisoning by sulfur and regeneration of metal synthesis gas catalysts.** Katzer, J.R. (Univ. of Delaware, Newark). Feb 1979.
In Heterogeneous catalysis research meeting.

38313 (LBL—8975, pp 15.-17.) **Reactive intermediates in catalytic methanation.** Lunsford, J.H. (Texas A and M Univ., College Station). Feb 1979.
In Heterogeneous catalysis research meeting.

38314 (LBL—8975, pp 25.-26.) **Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions.** Vannice, M.A. (Pennsylvania State Univ., University Park). Feb 1979.
In Heterogeneous catalysis research meeting.

38315 (LBL—8975, pp 34.) **Characterization of CO + H_2 catalysts for production of light hydrocarbons.** Massoth, F.E. (Univ. of Utah, Salt Lake City). Feb 1979.
In Heterogeneous catalysis research meeting.

38316 (LBL—8975, pp 64.-66.) **Catalytic synthesis of hydrocarbons.** Bell, A.T. (Univ. of California, Berkeley). Feb 1979.
In Heterogeneous catalysis research meeting.

38317 **Method for producing hydrocarbons from igneous sources.** Bechtold, I.C.; Emmerson, H.R. US Patent 4,140,184. 20 Feb 1979. Filed date 15 Nov 1976. 6p.
A method of producing a hydrocarbon or hydrocarbons is disclosed. The method employs carbon containing material, water and a reaction chamber in a hot subterranean formation. The method steps include: (a) forming an aqueous slurry containing said material in divided, flowable form, (b) passing the slurry into said subterranean formation for chemical interaction of said material at said elevated temperature to form said hydrocarbon, and (c) recovering said hydrocarbon.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 38400

38318 (PB—286722) **Management of swine manure for the recovery of protein and biogas. Final report.** Boersma, L.; Gasper, E.; Miner, J.; Oldfield, J.; Phinney, H. (Oregon Agricultural Experiment Station, Corvallis (USA)). May 1978. 309p. NTIS PC A14/MF A01.
Major findings of an investigation into the concept of nutrient and energy recovery from a swine waste management system are reported. Algae and bacteria were used to convert swine manure into methane-rich fuel gas and supplemental protein for animal feed. Waste heat from electricity generating plants was simulated to test its value in enhancing the biological recovery of nutrients and energy. The experimental facility was built adjacent to the Swine Research Center at Oregon State University and consisted of animal quarters with solid concrete floor and gutter to house 50 pigs, an anaerobic digester with a volume of 14 cu m, and 12 outdoor algae basins with a combined surface area of 24 sq m and a combined volume of 6,000 l. Manure was removed from the animal quarters by a gutter flushing system. The solids were separated from the liquids by gravity settling and then pumped into the digester for solubilization and recovery of biogas. The liquid phase of the diluted manure was pumped into the outdoor basins to serve as nutrient substrate for the growth of the high temperature strain 211/8K of Chlorella vulgaris as the predominant algal species. The algal biomass was concentrated by centrifugation and freeze dried. Its nutritional value as a protein source was determined by feeding trials with Long-Evans rats.

38319 **Mechanism of conversion of cellulosic wastes to liquid fuels in alkaline solution.** Molton, P.M.; Demmitt, T.F.; Donovan, J.M.; Miller, R.K. (Battelle Pacific Northwest Labs., Richland, WA). pp 293-316 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).
From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).
Conversion of cellulosic wastes into liquid oils is being practices on a pilot plant scale at Albany, OR, but the fundamental chemistry of the process is poorly understood. We report our findings on the aqueous alkaline digestion of pure cellulose, on a laboratory scale, in a closely related system. Out intent is to elucidate the reaction mechanisms involved in oil and tar formation, and to identify products of potential value. A 30 wt.-% aqueous slurry of pure cellulose in up to 1.2 N alkali (sodium hydroxide or carbonate), heated to 350°C over a 3.5 hour period showed a sharp discontinuity in heating rate at 265 to 270°C, indicating the onset of a discrete liquefaction reaction not hitherto observed. A series of 129 autoclave experiments analyzed by statistical methods indicated that carbon monoxide, while it promotes the attainment of high yields as claimed by the Bureau of Mines, is not ncessary for the reaction to proceed. Analysis of the products by ^{13}C-NMR, GC/MS, and gel permeation chromatography indicated that the non-volatile fraction of the oil consists of 44% aromatic carbon and 7% aromatic hydrogen, corresponding to a benzenoid polyaromatic with a substitution ratio of 5:1. Howver, oxygen content of the non-volatile fraction and distillable oil is approximately the same. Since the oil contains a series of polyalkylated furans, this suggests that the char is a poly-furan rather than a conventional asphaltene derivative. Volatile products from the oil fraction consist of furans, cyclic ketones, linear and branched alkenes, and phenolics. The high proportion of phenolics relative to normal crude oil could explain the observed highly corrosive nature of the biomass-derived oils.

38320 **Review of the energy from Marine Biomass Program.** Bryce, A.J. (General Electric Co., Philadelphia, PA). pp 353-377 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).
From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).
The Energy from Marine Biomass Program, sponsored by the Gas Research Institute and the Department of Energy, has the overall objective of determining the technical and economic feasibility of producing pipeline quality substitute natural gas (SNG) by conversion of kelp to methane. The kelp, Macrosystis pyrifera, will be cultivated in the open ocean on an artificial substrate, with critical nutrients being supplied by the upwelling of deep water, harvested and converted into fuel gas by anaerobic digestion. The program is divided into three phases: Concept Validation (1973—1982) - Process Development (1982—1987) and Commercial Demonstration (1992). Work to date indicates that the technical developments required are within the state of the art of current engineering and scientific techology. Preliminary cost estimates indicate that the cost of the product gas will be comparable to that from other sources of alternate gas supply Results from recent experiments indicate that the kelp biomass can be anaerobically converted with minimal predigestion tretment and that incubation at ambient temperatures (20 to 25°C), at no loss in digester performance, may be feasible. Recent engineering developments have produced a cost effective solution to the problem of providing a light weight, durable upwelling pipe.

38321 **Operation of an anaerobic digester at the Washington State Dairy Farm.** Smith, K.D. (Ecotope Group, Seattle, WA). pp 403-429 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).
From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).
This paper describes the operation of a full scale methane fermentation facility at the Monroe State Dairy Farm near Monroe,

WA. The system as designed and operated is a complete-mix,mesophilic anaerobic digester. Operating temperature is 35°C (95°F). Mixing is accomplished by gas recirculation. Two 189m³ (50,000 gallon) A.O. Smith Slurry store tanks are employed as digesters. The tanks are fully insulated with a conductance of U = .05, and an external counterflow heat exchanger is installed for preheating 10°C (50°F) influent with te 35°C (95°F) effluent. Ecotope Group has operated the system since September 1977 and under a contract with U.S. Department of Energy to test and evaluate the system. One of the two reactors is being operated to monitor the system performance. The system was designed to use manure from the farm's 350 cattle units (450 kg/1000 lb. animals). The single tank has been able to utilize manure from 200 cattle units. Fuel gas production has increased to a steady rate in excess of 200 m³ (7,000 ft³) per day. Carbon dioxide content of the gas has consistently been 35 to 37%. The design loading rate was 3.5 kg VS/m³ - d) (0.22 lb. US/ft³ - d) at a solids feed of 9% and aetention time of 17 days. Currently the loading rate is 7.0 kg VS/m³ - d (0.44 lb. VS/ft³ - d) at a 10% solids feed and a retention time of 12 days. The increase in loading rate, solids and decrease in retention time have increased gas production from 145m³ (5,100 ft³) to sustain yields greater than 200m³ (7,000 ft³). Mixing power has been reduced to increase net energy without subsequent decrease in performance. A gas engine/generator has been operated and efficiency is discussed.

38322 Conversion of forest residues to a methane-rich gas. Feldmann, H.F. (Battelle Columbus Labs., Columbus, OH). pp 537-556 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).

Battelle—Columbus is currently involved in a DOE sponsored program intended to improve the technology and the economics of gasifying wood residues by the use of direct gasification catalysts and the application of a unique gasification reactor system. Over the course of this program, several potentially attractive gasification catalysts as well as their method of application have been experimentally screened. One of the better catalysts uncovered during this study was wood ash itself. Other effective catalysts were CaO and K_2CO_3. Reactor design analyses indicated that in order to exploit the high reactivity of wood (and other biomass materials) it would be necessary to have a gasification reactor capable of operating at higher gas velocities than conventional reactors. Cost feasibility study indicated that reducing front end feedstock preparation costs would also have a major effect in reducing the final gas price. Therefore, a proprietary reactor system utilizing a dense-phase fluid bed through which an entrained heat carrier flows and into which the wood chips are injected was tested. Cold model studies indicate that with this system, excellent fluidized contacting can be achieved even with 1" x 1/4" chips in a 4-inch reactor. An economic analysis of wood chips gasification indicates that intermediate-Btu gas can be sold at prices competitive with other supplemental fuels.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 38591

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 38551

38323 (PB—286716) **Advanced methanol synthesis catalysts. Final technical letter report.** Klier, K.; Kraihanzel, C.S. (Lehigh Univ., Bethlehem, PA (USA)). Feb 1977. 7p. NTIS PC A02/MF A01.

Methanol and methyl fuel synthesis from coal generated feed gas was studied. The reaction conditions and gas compositions were investigated for optimization of the synthesis over the Cu/ZnO/Cr2O3 and Cu/ZnO/Al203 catalysts. Poisoning effects of sulfur containing gases were studied. Efforts to synthesize new catalysts based on zeolites and organometallic complexes were made. The investigations demonstrate that there are optimum concentrations of oxidizing gases (much less than 1% O2, about 2% CO2) and sulfur compounds (2 p.p.m. COS) at which the catalyst and the synthesis are stable and operate with maximum yield of methanol. The catalyst (RH-1-29-B) was fully characterized and found to be a high dispersion of ZnO microcrystallites (400-1000A) with 14% dissolved copper, supported on metallic copper, all in contact with large (1 micrometer) alpha-chromia crystals. Searches were made for a bimetallic or polymetallic transition metal complex which would homogeneously catalyze the synthesis of methanol or other low molecular weight hydrocarbons from carbon monoxide and hydrogen under less energy intensive conditions of temperature and pressure than are required by present industrial processes. Investigations demonstrated negative results for methanol synthesis.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 38400

PREPARATION

38324 (N—78-30798) **Assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation.** Stokes, B.O.; Wallace, C.J. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Aug 1978. Contracts NAS7-100;NSF AER-76-09093. 153p. NTIS PC A08/MF A01.

Ammonia production by Klebsiella pneumoniae is not economical with present strains and improving nitrogen fixation to its theoretical limits in this organism is not sufficient to achieve economic viability. Because the value of both the hydrogen produced by this organism and the methane value of the carbon source required greatly exceed the value of the ammonia formed, ammonia (fixed nitrogen) should be considered the by-product. The production of hydrogen by Klebsiella or other anaerobic nitrogen fixers should receive additional study, because the activity of nitrogenase offers a significant improvement in hydrogen production. The production of fixed nitrogen in the form of cell mass by Azotobacter is also uneconomical and the methane value of the carbon substrate exceeds the value of the nitrogen fixed. Parametric studies indicate that as efficiencies approach the theoretical limits the economics may become competitive. The use of nif-derepressed microorganisms, particularly blue-green algae, may have significant potential for in situ fertilization in the environment.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 38400

HYDRO ENERGY

38325 Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978). 205p. (NP—23687). $10.00.

The 31 papers in this book were prepared for the seminar Low-Head Hydroelectric Technology: Problems and Opportunities of an Alternative Energy Source, which was held at the University of Idaho on June 6 and 7, 1978. Most of the papers were delivered at the seminar; some were revised for publication here, and a few not delivered at the seminar were included. The funding for the seminar and the book was provided by the Idaho Water Resources Research Institute, the University of Idaho College of Engineering, the Idaho Department of Water Resources, the Idaho Office of Energy, the US Department of Energy, and indirectly, the Office of Water Research and Technology, US Department of the Interior. A separate abstract was prepared for each paper for Energy Research Abstracts (ERA); 25 are included in Energy Abstracts for Policy Analysis (EAPA).

38326 Impact of the world's energy problems on low-head hydroelectric power. Armstrong, E.L. pp 13-20 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

World population and gross national product projections indicate that developing countries will have an increasing share of both, with energy demand exceeding recoverable world energy supplies by the 1990s. A significant contribution can be made by low-head hydroelectric power, which has the advantages of being both an environmental asset and an economic catalyst, particularly for developing remote areas where small technology is more appropriate. Low-head hydroelectric energy can also be used for electrolysis to produce hydrogen for other fuel uses. Low-head projects have a short lead time and can be incorporated into existing projects. Traditional drawbacks to the concept are the high costs of regulatory requirements and hydrological feasibility studies, conflicting demands on water resources, and an uncertain market. These need to be reassessed in light of present world economics and the urgency for developing alternate energy sources. Economic studies show that standardization of design and equipment, modified licensing procedures, and shared hydrological data will help to lower costs. They also project an increase in Federal funding.

38327 Hydro choice: high, low, or no. Riggsbee, W.H. (Washington Public Power Sypply System, Richland). pp 40-42 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Five management considerations are presented to assist utilities in deciding whether to develop hydroelectric sites: (1) forecasts, such as those being made by the Pacific Northwest Utility Conference Committee, to determine the need for additional power; (2) a selection of one or a combination of available alternatives, one of which could be groups of small hydro plants; (3) evaluation of all potential hydro sites for either high or low-head facilities and unconventional hydro projects; (4) examination of associated environmental impacts of available technologies in relation to their effects on resources, hydroelectric being the most attractive technology using non-depletable resources; and (5) economic comparisons to determine the cost per kilowatt of installed capacity. While coal and nuclear are currently the most economical energy sources, the Pacific Northwest may select small hydro and other technologies in the long term.

RESOURCES AND AVAILABILITY

38328 Potential at existing impoundments. Willer, D.C. (Tudor Engineering Co., San Francisco, CA). pp 152-158 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

US energy shortages can be reduced with small power plants at existing dams. An available, renewable resource with a known technology that produces no pollution, hydro plants can often be built near population centers where employment opportunities are needed. The Corps of Engineers has identified nearly 50,000 dams that could produce up to 160 billion kilowatt-hours. Feasibility studies are proceeding in several states by companies like Tudor Engineering to examine the engineering and economic aspects and to weigh alternatives. Examples of how new designs can incorporate existing dams and impoundments emphasize the need to treat each site separately and innovatively. Equipment at some projects has been salvaged, refurbished, and put into use, for example. Traditional designs have been successfully challenged at some installations. Development of potential western sites could be expedited if low-head projects became eligible for government assistance.

38329 Some hydrologic analysis techniques. Heitz, L.F. (Univ. of Idaho, Moscow). pp 159-167 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Techniques for evaluating Pacific Northwest streams were used to find the maximum developable hydro power potential using power plants no smaller than 200 kilowatts and dams no higher than 20 meters. The analysis first determined the head and average discharge of the separate reaches and developed a typical duration curve to be used for feasibility studies. Where no stream gages were available, synthetic duration curves were developed. The various approaches used to develop generalized duration curves by teams in Idaho, Washington, and Montana are described. Power computations for each reach were made and a final sheet of reach characteristics was prepared for each location to sum up energy and power potentials for the total area. Questions were asked about variations in head, the need to determine monthly flows, and criteria for selecting reaches to study.

38330 Potential for hydroelectric development in existing irrigation systems. Warnick, C.C. (Univ. of Idaho, Moscow). pp 168-173 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Surveys of Idaho's canals and irrigation districts are being made to determine the potential for hydroelectric development. Examples are presented of conventional site analysis, where no modifications are made, and unconventional site analysis, where the canal system operation is changed. The major advantages of both conventional and unconventional canal developement are the increased operating efficiency, minimal environmental impact, and the existence of water control components and defined water rights. The major difficulties are the costs of maintaining and operating scattered small sites, seasonal fluctuations of the stream, competition with irrigation interests, and the possible lack of institutional mechanisms to permit development. Simultaneous development of numerous sites, using standardized equipment, could offset some of the disadvantages.

38331 Studying the Northwest's low-head hydro potential. Lomax, C.C.; Robinette, M.J. (Washington State Univ., Pullman). pp 174-176 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Phase one of water resources studies in Idaho, Oregon, Washington, and part of Montana was made to determine stream gradients, flow rates, and flow duration on reaches where one or more dams could be built. Streams with existing dams and reservoirs were excluded from the study. Phase two will identify promising sites and possible ownership restrictions. Six such sites are described to illustrate the kinds of environmental, economic, and political constraints that will affect development. While detailed feasibility studies will determine the value of low-head hydroelectric facilities at these sites, many were selected for high-head dams.

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 38329

38332 (PB—286739) Operations of the national weather service. (National Weather Service, Silver Spring, MD (USA)). Jan 1978. 316p. NTIS PC A14/MF A01.

The National Weather Service (NWS), under the National Oceanic and Atmospheric Administration (NOAA), has a vast operating program. The provision of forecasts and weather warnings to the general public and specialized users is the heart of the NWS operations. Warnings from both WSFOs and WSOs are issued for severe weather such as hurricanes, tornadoes, severe thunderstorms, flash flooding, and extreme winter weather. The National Severe Storms Forecast Center in Kansas City, MO, and the National Hurricane Center in Miami provide the main support for the warning program. The River Forecast Centers issue river stage forecasts for use by the public as well as special flow forecasts for use by irrigation, navigation, and hydroelectric power generation interests. The RFCs disseminate most special flow forecasts directly to the users. Most WSFOs and WSOs support the RFCs via the collection and relay of hydrologic data and issue generalized flash flood watches and warnings. Other less well known NWS activities include oceanographic, overseas, and space operation support services. Another important aspect of NWS operations is the acquisition of meteorological data.

PLANT DESIGN AND OPERATION

38333 Current power plant. Nickell, J.H. US Patent 4,142,823. 6 Mar 1979. Filed date 18 Jul 1977. 4p.

A current power plant is described that includes a shaft mounted turbine wheel for employment in water current, a housing adjacent the impeller and to which the shaft extends, a ramp positioned on the upstream side of the impellar, and a frame on which the turbine wheel is mounted. The frame is mounted by rollers on a tract such that the impeller and frame may be rolled on the tracks inside the housing, whereafter doors are closed, and water around the turbine wheel may be pumped out to facilitate turbine repair.

38334 Straflo turbine. Moser, R.E. (Sulzer Brothers Inc., New York, NY). pp 79-84 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The concept of a horizontal turbine dates back to 1919, but technology was not sufficiently advanced until the Straflo turbine was developed in the 1970's. With the generator and turbine forming a single unit, the Straflo is simple, compact, and efficient. There is no drive shaft. The design gives ample periphery space to attach the generator and enough natural inertia to dampen power fluctuations. It is necessary to use suitable bearings and sealing arrangements in order to use these advantages. Straflo seals and bearings are described, with diagrams showing various configurations. Test results are given which indicate the Straflo is an economically viable choice for low-head hydro power stations.

38335 Ossberger cross-flow turbine. Stapenhorst, F.W.E. (F.W.E. Stapenhorst, Inc., Montreal, Quebec). pp 85-88 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The Ossberger Turbine Co. in West Germany was the only manufacturer to produce small turbines for small hydro exclusively while other manufacturers concentrated on making larger, more powerful turbines. The Ossberger cross-flow turbine is designed so that the water passes the runner blades from the outside to the center and then recrosses from the inside outward, clearing the runner blades of debris in the process. A flat efficiency curve makes it the only turbine that can cover a wide range of heads and work efficiently with low heads. Variations in flow are dealt with at the

penstock by guide vanes. Installation can be done quickly and standard local equipment can be used as well as the German hardware package. A demonstration plant in New York State will include two rehabilitated small hydro stations equipped with Ossberger cross-flow turbines. The project also demonstrates the need for a shortened license procedure.

38336 Bulb units for low-head hydroelectric generation. Chapus, E.E.; Haddad, C. (Alsthom Atlantic, Inc., New York, NY). pp 89-96 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Bulb units were designed as a way to improve the technology and economics of low-head hydro by placing turbine and generator horizontally in a watertight steel housing directly in the conduit. A summary of site conditions is given for both large and small bulb units. Compared with the vertical Kaplan unit, the bulb is found to use water energy more efficiently. A simple, compact powerhouse, with lower component costs provide the major economic advantages. The technical advantages include a higher specific output, better cavitation characteristics, and better efficiency. Sluice operation and reversibility make the bulb operation more flexible. Maintenance is simplified with the bulb unit, whose reliability has been well demonstrated in France.

38337 Tube turbines. Pfafflin, G.E. (Allis—Chalmers Corp., York, PA). pp 97-102 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Tube turbines, while favored for design simplicity and economics, are limited in application to hydroelectric power stations with heads ranging from two to less than 20 meters. An efficient installation in Norwich, Connecticut and other examples illustrate the optimum use of tube turbines in unattended mini low-head plants or for certain rehabilitated or upgraded low-head plants of small unit capacity. Diagrams are used to present tube turbine installations at six sites.

38338 Very-low-head hydroelectric generation. Mercer, A.G. (Northwest Hydraulic Consultants Ltd., Vancouver, British Columbia). pp 103-113 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Very-low-head hydro plants, those having less than 25-foot heads, are seldom economically or environmentally feasible solely for power generation, but they can enhance developments for water storage, navigation, or flood control. There are two main groups of low-head units: turbine arrangements that control flow with a spiral case and wicket gates and tubular turbines that simplify flow passage and reduce structure size. A review of the present state of the art covers the development of bulb units, head increasers to reduce excess spillway flow, and induction generators. Cost estimates and comparisons are presented and show horizontal plants to be used economically in Europe, but not in North America. Low-head plants, while having aesthetic advantages, have a larger and slower turbine, heavier and slower generators, larger slow conduits, and higher costs; while capacity, efficiency and cost/benefit ratios are lower. A table lists 150 world-wide installations in the very-low-head range. 14 references.

REGULATIONS AND LICENSING

38339 Overview of existing Federal programs in low-head hydro. Gilmore, C. (Dept. of Energy, Idaho Falls, ID). pp 129-132 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The Federal low-head hydroelectric program, after one year of existence, has enjoyed vocal public support. Undeveloped potential power resources are estimated at 26.6 million kilowatts at existing sites and another 173.4 million kilowatts with new development. A DOE schedule of goals gives first priority to giving appropriate help to the private and public sectors to rehabilitate existing dams. The program is characterized by six elements: resource assessment, engineering development, institutional and legal considerations, environment and safety, technology transfer and information dissemination, and demonstrations. Government help, such as loan assistance, is recognized as important to developing renewable resources, but industries are urged to proceed developing feasible sites on their own initiative.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 38339, 38572

38340 What Idaho Power has learned. Arms, W.D. (Idaho Power Co., Boise). pp 33-35 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Idaho Power, one of the first to form a power pool and to develop low-head hydroelectric power, has learned that systems management is essential to keep operating expenses down. Idaho Power has learned that low-head hydro is not economically feasible in a number of situations because many of the costs and regulations are the same as for a larger plant. Suitable sites are often not available if water flow is right and the projects are vulnerable to changes in the stream flow. Environmental intervenors have prevented some sources from producing power. The bulb turbine has been found to be more efficient and economical, although its lower inertia limits application. Water scarcity and the consideration of water resources are integrated into economic analyses before decisions are made to develop low-head hydro resources.

38341 WWP view. Felgenhauer, D.L. (Washington Water Power Co., Spokane). pp 36-39 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Washington Water Power (WWP) is interested in low-head hydroelectric power whenever it represents the most environmentally and economically sound alternative. Resource planning engineers study annual streamflow patterns to evaluate alternatives at specific sites. The streamflow indicates whether incremental energy can be produced to offset the cost of the facility. A plot of generating costs and plant capacity is made to determine the optimum average plant size. The costs and benefits of integrating a low-head project into an existing high-head system are described.

38342 Economics of small hydroelectric projects. Williamson, J.V. (R.W. Beck and Associates, Seattle, WA). pp 51-57 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The economic feasibility of small hydro projects is examined using two case studies, one with municipal and one with Rural Electric Administration (REA) financing. Municipal tax-exempt financing is first calculated for an East Coast project consisting of six plants and dam heights ranging from 10 to 165 feet. The project's costs are also calculated for competing oil-fired generation and continued power purchases for comparison. Municipal financing is shown to be economically feasible for the hydro project, oil-fired combustion turbines being the least costly alternative. High-interest, short-term REA financing is not found to be feasible.

38343 Some basic considerations. Willer, D.C. (Tudor Engineering Co., San Francisco). pp 58-64 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The basic economic considerations of low-head hydro projects are described for both buyers and sellers in two categories: (1) a small municipality purchasing some of its power, and (2) a public-irrigation or water district that owns the site for potential power generation. Some small municipal projects have legal barriers from prior agreements not to develop a power-generating capability; but, for others, economics favors a small-hydro project over continued power purchases. Water districts already owning a dam or pipeline may also have economic and environmental restraints on use of the water reources other than for the initial purpose. The example of several projects illustrates what can be done to better utilize water resources by producing energy in a non-polluting, economical way with small hydro technology.

38344 Economics of low-head hydro: US case studies. Chen, H.H. (Harza Engineering Co., Chicago, IL). pp 65-69 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Economic analysis of low-head hydro projects is described, using several case studies based on cost comparisons with alternative sources of energy. A stream-flow-duration curve is developed to determine the project's power and energy potential. Because fluctuations in the operating head can curtail and even prohibit power generation, the general rule is to select installed capacity on the basis of average river flow. Capital costs for low-head hydro, which is generally more expensive than large projects, are then compared with the costs of alternative projects able to provide the same incremental capacity and the capital and energy costs are compared for the system over the project's service life. Hydro projects are shown to increase in value over time relative to oil- or gas-fired projects because of system fuel costs and the effects of inflation.

38345 Economic comparison of five hydroelectric projects in Idaho. Engebretsen, A.R. (International Engineering Co., Inc., San Francisco, CA). pp 70-74 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Feasibility studies of five Idaho projects are compared in order to illustrate the site and river characteristics that make hydroelectric energy economical. Located on the Snake, Boise, and two branches of the Payette Rivers, the projects range in head size from 20 to 1000 feet. Recreational and transmission costs are not included in the study. None of the projects will change the rivers' present discharge patterns. On the basis of these comparisons it is observed that, except for low dams with seasonal discharge, power development at existing dams is an economical way to increase capacity. Because of equipment and construction costs, a gradient of 2.5 percent is needed. Technology improvements and the high cost of other energy sources now make development of main rivers with poor foundations feasible.

38346 Marketing low-head hydroelectric power. Reams, P.W. (Bonneville Power Administration, Portland, OR). pp 75-77 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Power costs from low-head hydroelectric sources could be an economical and environmentally acceptable way to meet load growth in the Pacific Northwest. Most low-head projects are run-of-river, with no storage capability or steady flow of water. Marketing this type of variable energy introduces problems that require the support of a large power system, but there is a question of how many small plants a system can support. Another option has been proposed by the Weyerhaeuser Company, which would generate power for the Bonneville Power Administration (BPA) to store and transmit to industries. The project might not be fully utilized, however, if surpluses caused BPA to reject Weyerhaeuser's power on occasion. The contracting companies' guarantees of a minimum rate of return would ensure economic viability, however. Canal drop sites look more promising than run-of-river plants, but no feasibility studies have been made.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38338

38347 Let's not have another Hells Canyon impasse. Nee, J.A. (US Fish and Wildlife Service, Boise, ID). pp 147-148 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Low-head horizontal turbine hydroelectric power can change the adversary approach power developers and conservationists took toward the Hell's Canyon debate (building a series of high-head dams on Snake River) into one of cooperation and understanding. Mutual trust between the opponents is essential because of the narrow benefit-to-cost ratio of small projects. Discussion between adversaries must take place on neutral ground, such as a university, where individual goals are more easily modified in a cooperative atmosphere.

LAND USE AND AESTHETICS

38348 Environmental and aesthetic aspects of low-head dams. Woodworth, J.R. (US Bureau of Reclamation, Boise, ID). pp 143-146 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Proposals for low-head dams, while less environmentally damaging than high dams, need to provide facilities for fish passage, to design acceptable poles and to coordinate lines with other transmission lines. The concept of no-dam generation by combining an underwater generating system and buried electric cables is technically feasible, but costly, for an environmentally sensitive area. A more practical solution has been to put penstocks across S-shaped curves of a stream as a way to manage fish and waterfowl stocks where there is enough drop to produce a head. Refurbishing abandoned small dams is another strategy. Each proposal must be evaluated on its own merits. In response to questions, the author elaborated on techniques in the Northwest to protect fish migration, prevent silting, and provide financing for the projects.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 38509, 38510, 38912

38349 (NTISUB/D—450) **Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. vp. New Mexico Univ., Albuquerque.

This bibliographic series cites and abstracts the literature and technical papers on electrical power generation primarily through solar thermal processes, the heating and cooling of buildings with solar thermal energy, and components applied to solar thermal energy utilization.

38350 (NTISUB/D—451) **Solar thermal power generation, 1978. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. vp. New Mexico Univ., Albuquerque.

This bibliographic series sites and abstracts literature and technical papers on electrical power generation primarily through solar thermal processes. The quarterly volumes are divided into ten categories: Energy Overviews; Solar Overviews; Economics and Law; Thermal Power; Thermionics; Ocean Thermal Differential; Wind Power Conversion; Biomass; Residential Systems; and, Large Scale Photovoltaic, Hydrogen Production, and Other. Each quarterly volume is compiled from a wide variety of data bases, report literature, technical briefs, journal articles and other traditional and non-traditional sources.

38351 (NTISUB/D—453) **Solar thermal components, 1978. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. vp. New Mexico Univ., Albuquerque.

This bibliographic series cites and abstracts literature and technical papers on components applied to solar thermal energy utilization. The quarterly volumes are divided into ten categories: Material Properties; Flat Plate Collectors; Concentrating Collectors; Thermal Storage; Heat Pumps; Coolers and Heat Exchangers; Solar Ponds and Distillation; Greenhouses; Process Heat; and, Irrigation Pumps. Each quarterly volume is compiled from a wide variety of data bases, report literature, technical briefs, journal articles and other traditional and non-traditional sources.

38352 (SERI/SP—11-142) **SERI: the first year.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1978. Contract EG-77-C-01-4042. 16p. Solar Energy Research Inst., Golden, CO.

This brochure indicates the highlights of SERI's first year. The organization, facilities, and mission are presented. (MHR)

38353 (SERI/TR—51-161) **Implementation of state solar incentives: research, development, and demonstration programs.** Green, B. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 41p. Dep. NTIS, PC A03/MF A01.

The states view high-risk, capital-intensive R, D, and D solar projects as being most appropriately performed by the Federal government and private industry. For the states, solar energy R, D, and D programs function primarily in support of commercialization efforts. This close programmatic relationship between solar energy R, D, and D and commercialization efforts at the state level is a function of a more-immediate or near-term emphasis within state-level R, D, and D programs. In fact, some states perceive their solar energy R, D, and D programs as predominantly a commercialization activity. A brief review of available R, D, and D incentives at the state level is given. Then, the experience of omplementing research programs in New Mexico, Montana, California, and Florida is given in some detail. This information should be useful to the states and the federal government in program design, implementation, evaluation, and redesign. The following is included: a catalogue of state solar energy R, D, and D programs; the choice of case-study states; program-implementation experience in the case-study states; and observations, recommendations, and conclusions.

38354 Space and energy. Napolitano, L.G. (ed.). Elmsford, NY; Pergamon Press Inc. (1977). 492p. (CONF-7509184—).

From 26. International Astronautical Congress; Lisbon, Portugal (21 Sep 1975).

Twenty-six papers were presented on the general topics of space and energy, engineering and life sciences, space systems and space technology, and applications satellites. Separate abstracts were prepared for five of these papers; the remaining ones were outside the subject scope of ERA. (RWR)

38355 Earth, an open system. The use of solar energy. Jaumotte, A.L. (Univ. of Brussels, Belgium). pp 3-27 of Space and energy. Napolitano, L.G. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 26. International Astronautical Congress; Lisbon, Portugal (21 Sep 1975).

The earth's thermal balance sheet is described and the utilization of solar energy is discussed. Solar heating, solar-powered irrigation, photosynthesis, solar concentrators, solar power stations, solar cells, and satellite solar power stations are discussed. (WHK)

RESOURCES AND AVAILABILITY

38356 (CONF-780337—P2, pp 4p, Book 1, Paper 2) **Solar resource: motion and amplitude.** Place, W. 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The emphasis in this presentation is on visualizing the implications of planetary motion to the earth dweller's perception of the sun.

38357 (CONF-780337—P3, pp 4p, Book 1, Paper 7) **Estimation of atmospheric radiation for clear and cloudy skies.** Clark, G.; Allen, C. (Trinity Univ., San Antonio, TX). 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A year of nocturnal infrared net radiation measurements have been completed in San Antonio, Texas. This data was used to calculate statistical correlation equations which allow the prediction of hourly atmospheric radiation from commonly available weather data. Estimation of clear sky atmospheric radiation requires surface dry bulb and dewpoint temperatures. Cloud cover corrections can be made using tenths of opaque sky cover.

38358 (PB—285129) **Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper.** Duffield, C. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). 1978. 165p. NTIS PC A08/MF A01.

This report presents a new conceptual framework within which the countless diverse details of the burgeoning solar energy field can be unified and easily comprehended. The bibliography offers a small but typical selection from the solar energy literature. It includes mostly recent items (1975-1977), and a few important older ones. Major focus is on introductory and review publications, and specialized works dealing with arid lands and water.

ECONOMICS

REFER ALSO TO CITATION(S) 38380, 38385, 38390

38359 (CONF-780337—P1, pp 5p, Book 1, Paper 3) **Preliminary economic evaluation of generic passive solar energy system/building applications.** Davidoff, P.; Narayanan, P.; Hirshberg, A. (Booz, Allen and Hamilton Inc., Bethesda, MD). 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

To better understand the economics of passive solar energy systems for the purpose of national policy planning, and to provide for a means of incentives analysis, a simplified cost, performance, and economics model is needed. By describing generic building/system applications, and developing a data base that varied as: four building types, five generic passive solar systems, two levels of conservation, new and retrofit costs, and for eight cities, it is felt that an understanding of passive applications can be achieved. This paper presents details of the data base and modeling approach.

38360 (DOE/EIA—0102/51) **Macroeconomic and sector implications of installing 2.2 million residential solar units.** Earley, R.F.; Mohtadi, M.M.; Rossidivito, E.L.; Serot, D.E.; Weisman, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 102p. Dep. NTIS, PC A06/MF A01.

Accelerated residential use of solar energy through 1985 will affect the economy. Direct impacts result from the design, manufacture and installation of the solar units and from the energy savings brought about by those units. These direct impacts are accompanied by indirect macroeconomic and interindustry effects generated by the solar installation program. The Office of Conservation and Solar Applications has requested an analysis of the macroeconomic and sector output and employment implications of a residential solar installation program of 2.2 million solar units cumulatively installed through 1985. This Analysis Memorandum presents the results of that analysis.

38361 (SERI/TR—51-160) **Implementation of state solar incentives: financial programs.** Ashworth, J. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 64p. Dep. NTIS, PC A04/MF A01.

This report examines the experience of selected states in implementing financial incentives for solar energy. While the range of available fiscal mechanisms is surveyed in Section 3.0, the emphasis throughout this report will be upon major incentives - those which possess the potential to have a significant impact on the rate of installation of solar energy systems, either through a reduction in the market cost to buyers or through the removal of a legal or institutional barrier to the use of solar energy systems. The objective of this study is not to judge the design of state incentive programs or to criticize the activities of rule-setting and administering agencies. Rather, the emphasis will be on gathering, assessing, and disseminating information resulting from the practical experience of officials in pioneering states. Specifically, the focus is on what factors are important for the translation of a law into a workable solar energy financial incentive program. It is hoped that this information will be useful to officials of states contemplating the adoption of incentives of solar energy, to state officials considering the modification of existing incentives, and to federal policy analysis seeking to promote the diffusion of solar technologies.

38362 (SERI/TR—51-162) **Implementation of state solar incentives: state testing and certification.** Odland, R. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1979. Contract EG-77-C-01-4042. 38p. Dep. NTIS, PC A03/MF A01.

Implementation experiences of several states with testing and certification programs. The primary purpose is to provide information to other states and local governments that are contemplating adoption and implementation of such programs. A secondary purpose is to provide information to the Federal government for their use in formulating national policies recognize and accommodate regional diversity. No attempt was made to survey all of the states that habe adopted some type of testing and certification program. Only four states were examined. The activities of Florida, California, Minnesota, and Oregon are examined. Florida and California have testing and certification programs, both currently voluntary although certification in Florida will be required after January 1, 1980, and certification in California may be made a condition of their state income tax credit. Minnesota has a system whereby the characteristics of solar equipment are to be disclosed to the buyer; the manufacturer is charged with developing the necessary information. Oregon has several programs that require qualifying standards or criteria to be developed. One Oregon program requires certification by a state agency.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 38353, 38362, 38599

38363 (CONF-780337—P1, pp 4p, Book 1, Paper 5) **Report of the solar passive subcommittee for the Minnesota Energy Agency: review and update.** Pfister, P.J. (Architectural Alliance, Minneapolis, MN). 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This paper summarizes the report of the Solar Passive Subcommittee of the Minnesota Alternative Energy Research and Development Policy Formulation Project (MAERDPFP). The report was prepared in the fall of 1976 under mandate from the Minnesota Legislature to assess the potential impact that energy conservation and passive solar collection can have on energy supplies in Minnesota. Recommendations of the Solar Passive Subcommittee and ensuing developments are summarized below.

38364 (CONF-780337—P1, pp 5p, Book 1, Paper 6) **California's passive program.** Hunt, M.B. (California Energy Commission, Sacramento). 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The California Energy Commission Solar Office passive program focusses on rapid deployment of passive structures. The creation of the Energy Commission in 1973 and two bills in 1977 requiring development of a passive manual and prototypes and offering a 55% tax credit for solar systems, including passive systems provided the setting for this effort. Federal funding could help accelerate this program.

38365 (DOE/TIC—10016) **Passive solar energy focus group results.** (Market Facts, Inc., Washington, DC (USA)). 1978. Contract EV-78-C-01-6458. 44p. Dep. NTIS, PC A03/MF A01.

The following are covered: the current state of passive solar energy, barriers to the commercialization of passive solar energy, possible actions for surmounting barriers to commercialization, and the role of the Federal Government in commercialization of passive solar energy. (MHR)

38366 (HCP/R4040—02) **Social assessment of on-site solar energy technologies. Topical report.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Apr 1979. Contract EG-77-G-01-4040. 251p. Dep. NTIS, PC A12/MF A01.

The results of an assessment of the impact of on-site solar energy technology upon society are presented. The assessment utilizes the methodology of social indicators. Twenty-five appropriate social descriptions provide the framework for assessing the technologies of solar space heating and cooling, solar water heating, wind energy conversion, fuelwood and photovoltaics. The report concentrates upon those areas which cause concern as these forms of solar energy realize increasing acceptance and usage by individual citizens.

38367 (SERI/TP—53-123) **Solar energy commercialization and the labor market.** Mason, B.; Ferris, G.; Burns, B. (Solar Energy Research Inst., Golden, CO (USA)). 1978. Contract EG-77-C-01-4042. 30p. (CONF-781235—4). Dep. NTIS, PC A03/MF A01.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

The success of a new technology does not depend only on its technical and economic feasibility. Evidence from the diffusion of non-solar technologies suggests that unless the product can be accepted and integrated into existing institutional processes and practices and can meet specific user and technology delivery system requirements, acceptance and diffusion of the technology will be slow. This paper discusses the potential impacts of solar energy commercialization on labor demand, and conversely, the potential impacts of the labor supply system on solar energy commercialization. Various participants in manpower training programs are examined, and alternative implementation channels to meet the labor needs of an emerging technology are discussed.

38368 (SERI/TR—62-148) **Organized labor and solar energy.** (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 67p. Dep. NTIS, PC A04/MF A01.

This report focuses on the question of how the SERI and DOE can work to increase the role of trade unions as producers, installers, and consumers of solar energy technology. It provides an overview and understanding of the skills and jurisdictions of organized labor and how this community might best prepare itself for the transition to working with and using solar technologies. It further discusses the new growing market for the skills of the manufacturing and construction crafts as well as the areas in which specific unions might have the greatest impact on the commercialization of solar technologies. The report includes a summary of the National Labor Leadership Workshop on Solar Technology (June 1978) and provides a basis for continued communication with this most important and influential part of the working and consuming public.

38369 **Potential for state government assistance to community solar energy enterprises.** Yudelson, J. Sacramento, CA; Business and Transportation Agency (1979). 12p. (CONF-781201—1). State of California SolarCal Office, 921 Tenth St., Sacramento, CA 95814.

From National conference for developing local public-private enterprises; Philadelphia, PA, USA (3 Dec 1978).

Some potential roles for a state government in assisting local public—private ventures are described, especially those active in solar energy. The following are covered: barriers and solutions for local solar enterprises, criteria for choosing enterprises, potential of state government in California, and special programs of the SolarCal Office. (MHR)

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 38402

38370 (COO—4546-5) **Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977—September 1978.** Sites, J.R.; Greenberg, A.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 28p. Dep. NTIS, PC A03/MF A01.

The primary objective of this research was to build, test, and evaluate the glow discharge amorphous silicon facility. Amorphous silicon films deposited by our glow discharge technique were evaluated optically and electrically and found comparable to those from other laboratories. Analysis of previous heterojunction measurements suggests a multistep tunneling mechanism in the IT0/Si diode.

38371 (DOE/JPL/954527—7) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Ninth quarterly progress report, May 12, 1978—August 12, 1978.** (Springborn Labs., Inc., Enfield, CT (USA)). Oct 1978. Contract NAS-7-100-954527. 54p. Dep. NTIS, PC A04/MF A01.

The technical activities were directed toward further assessment of protective outer cover materials, an examination of the outdoor weathering effects on various plastics, the development of an ethylene/vinyl acetate copolymer pottant, and a mechanical analysis of composite substrate materials. Permasorb-MA, a copolymerized ultraviolet absorber in an acrylic coating vehicle, was evaluated for its effectiveness by the protection it provided to unstabilized polypropylene. The weathering effects on eleven polymers exposed to twelve months of weathering in Phoenix, Florida, and under EMMAQUA were evaluated by determination of tensile strengths, elongations, optical transmission, etc. Development efforts were applied to ethylene/vinyl acetate ccopolymer (EVA) in order to test the viability of this compound as an experimental pottant. A mechanical engineering analysis of composite structural materials useful as substrates is included.

38372 (DOE/JPL/954853—3) **Array Automated Assembly, Phase 2. Quarterly report for the quarter ending June 30, 1978.** Taylor, W.E.; Kimberly, W.; Mardesich, N.; Pepe, A. (Spectrolab, Inc., Sylmar, CA (USA)). Aug 1978. Contract NAS-7-100-954853. 87p. Dep. NTIS, PC A05/MF A01.

The Automated Array Assembly Task is a process development task. The overall goal is to advance solar cell and module process technology to meet the 1986 goal of a production capacity of 500 megawatts per year at a cost of less than $500 per kilowatt. Work performed during the quarter ending June 30, 1978 is covered. Discussions are included on diffusion masking dielectric evaluation, P^+ back surface fields formed by firing screen printed aluminum back contacts, screen printable glass systems for use as isolation dielectrics, screen printed front contact metallization and stresses caused by thermal cycling silicon solar cells adhesively bonded to glass superstrates. SEM pictures of the fritted layer at the interface between the front metallization and silicon are presented. Results of an x-ray topographic examination of the silicon under and adjacent to printed and fired patterns of fritted conductor and dielectric pastes are given.

38373 (DOE/JPL/954853—4) **Array automated assembly. Phase 2: quarterly report for the quarter ending September 30, 1978.** Taylor, W.E.; Kimberly, W.; Mardesich, N.; Pepe, A. (Spectrolab, Inc., Sylmar, CA (USA)). Oct 1978. Contract NAS-7-100-954853. 45p. Dep. NTIS, PC A03/MF A01.

Problems with excessive junction shunting previously reported were found to be associated with a malfunction discovered in one of the printers. Aluminum contamination of the front surface and junction edge were also identified as sources of shunting, as was damage to the tetrahedral peaks during handling of diffused wafers. Additional compositional variations of titania precipitated and baria—magnesia borosilicate glasses were prepared to improve fusion and maturation characteristics. An intensive effort was made to integrate the diffusion mask process into the process sequence. This attempt has been unsuccessful. All cells fabricated have had very low output attributable primarily to low shunt resistance. Alcoa 1401 and AMPAL (Atomized Metal Powder, Inc.) aluminum powders were tested as the base for making screen printing pastes for back surface P+ contacts. Time—temperature firing matrix experiments showed that optimum conditions were different for the two different pastes: 850°C and 20 seconds for the paste based on Alcoa 1401 powder and 825°C for 30 seconds for the paste based on the AMPAL powder. Additional peel strength data on protective coating materials were gathered. The effect of exposure to a swelling solvent on coating layers was added as a test of adhesive bonding to the substrate and the effectiveness of primer coupling agents. The preliminary tests indicate ability to discriminate between different primers used with RTV-type silicon coatings.

38374 (DOE/JPL/954865—3) **Phase 2. Array automated assembly task, low cost silicon solar array project. Quarterly technical report no. 2, April 1—June 30, 1978.** Jones, G.T.; Rhee, S.S.; Allison, K.L. (Sensor Technology, Inc., Chatsworth, CA (USA)). 1978. Contract NAS-7-100-954865. 86p. Dep. NTIS, PC A05/MF A01.

Data was gathered and analysis continued on seventeen process groups. Five process groups were completed. They include: solar cell test data acquisition, plasma etching of resist, laser trimming and holing operation, wafer surface preparation and wafer printing. Preliminary results to date show very promising results for other task groups. Silicon nitride antireflective coating equipment with modifications has high potential for low-cost automation. An electroless nickel plating system has been designed and is under construction to demonstrate the processing of 1500 wafers per hour. The conceptual design of two fully automated laser trimming and holing lines has been completed and has very promising low-cost, high volume potential. The spray-on dopant model equipment construc-

tion is nearly completed. Preliminary spray-on tests have shown very good results. Dopants can be sprayed on without wafer edge overlap and good dopant uniformity can be achieved. SAMICS has been applied to most process groups. It has been very effective in analyzing process steps for low-cost potential for meeting the LSA 1986 goals.

38375 (DOE/JPL/954887—4) **Continuous Czochralski process development. LSSA large area silicon sheet task. Annual report, October 1977—September 1978.** Rea, S.N. (Texas Instruments, Inc., Dallas (USA)). Oct 1978. Contract NAS-7-100-954887. 56p. Dep. NTIS, PC A04/MF A01.

A Czochralski crystal growing furnace was converted to a continuous growth facility by installation of a premelter to provide molten silicon flow into the primary crucible. The basic furnace is operational and several trial crystals have been grown in the batch mode. The key element in this continuous Czochralski process is the premelter and considerable effort has been expended in developing a suitable design. Numerous premelter configurations have been tested both in laboratory-scale equipment as well as in the actual furnace. The best arrangement tested to date is a vertical, cylindrical graphite heater containing small fused silicon test tube liner in which the incoming silicon is melted and flows into the primary crucible. The premelter is positioned immediately over the primary melt. Economic modeling of the continuous Czochralski process has continued utilizing the IPEG option of SAMICS. The influence of both crystal size and total furnace run size have been examined. Results of these studies indicate that for 10-cm diameter crystal, 100-kg furnace runs of four or five crystals each are near-optimal. Costs tend to asymptote at the 100-kg level so little additional cost improvement occurs at larger runs. For these conditions, crystal cost in equivalent wafer area of around $20/m^2$ exclusive of polysilicon and slicing is obtained.

38376 (DOE/JPL/954888—3) **Silicon sheet growth development of the large area silicon sheet task of the low cost silicon solar array project. Third quarterly progress report, April 1—June 30, 1978.** (Kayex Corp., Rochester, NY (USA)). 1978. Contract NAS-7-100-954888. 30p. Dep. NTIS, PC A03/MF A01.

The continuous Czochralski (CZ) equipment is to be designed and constructed as one portion of this program. Concurrently, methods and process parameters will be developed for continuous CZ in the second portion of the effort. The goal is to demonstrate the growth of 100 kilograms of single crystal material using only one crucible. The approach is to suitably modify a Hamco CG2000 crystal grower to demonstrate that continuous CZ is feasible by periodic melt replenishment (recharging) of 12-inch (and later 14-inch) diameter crucibles. The program plan for equipment design and construction is on schedule after some delays in the completion of the polyweight/recharge system, which has now been fully constructed and installed on the crystal grower. The grower was disassembled to make modifications to the chambers to enable the recharge system to be installed. Other equipment modifications, i.e., melt level control via weight, 14-inch hot zone, and a powder/lump recharge system are in process and are expected to be completed on schedule. The process development program is also on schedule. Two recharges (three melts and ingot growth cycles from the same crucible) have been demonstrated. 42.5 kilograms of single crystal material have been pulled from one crucible by melting to total of 48.7 kilograms in three successive melts, for a cumulative pulled yield of 87%. The 10 cm diameter grown crystal material was approximately 80% of zero dislocation structure. A SAMICS/IPEG analysis of two types of continuous CZ growth is presented.

38377 (MIT-EL—78-007) **Economic analysis of grid-connected residential solar photovoltaic power systems.** Carpenter, P.R.; Taylor, G.A. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). May 1978. Contract EX-76-A-01-2295-037. 147p. Dep. NTIS, PC A07/MF A01.

The question of the utility grid-connected residential market for photovoltaics is examined from a user-ownership perspective. The price is calculated at which the user would be economically indifferent between having a photovoltaic system and not having a system. To accomplish this, a uniform methodology is defined to determine the value to the user-owner of weather-dependent electric generation technologies. Two models are implemented for three regions of the United States, the first of which is a previously developed simulation of a photovoltaic residence. The second is an economic valuation model which is required to translate the outputs from the simulation into breakeven array prices. Special care is taken to specify the input assumptions used in the models. The accompanying analysis includes a method for analyzing the year-to-year variation in hourly solar radiaion data and a discussion of the appropriate discount rate to apply to homeowner investments in photovoltaic systems. The results of this study indicate that for the regions characterized by Boston, Omaha, and Phoenix, under the assumptions noted, photovoltaic module breakeven costs for the residential application are in the range of $.68, $.43 and $1.27 per peak watt respectively.

38378 (N—78-27530) **High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 1.** Costogue, E.N.; Young, L.E.; Brandhorst, H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jun 1978. Contract NAS7-100. 152p. NTIS PC A08/MF A01.

The technology readiness of solar array designs for future planetary missions, and particularly for the Halley's comet ion drive space vehicle, is assessed. The effort involves critical component technology for the development of candidate solar array designs, and technology development planning. Results and conclusions are presented in summary form.

38379 (N—78-27531) **High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2.** Costogue, E.N.; Young, L.E.; Brandhorst, H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jun 1978. Contract NAS7-100. 514p. NTIS PC A23/MF A01.

Development efforts are reported in detail for: (1) a lightweight solar array system for solar electric propulsion; (2) a high efficiency thin silicon solar cell; (3) conceptual design of 200 W/kg solar arrays; (4) fluorocarbon encapsulation for silicon solar cell array; and (5) technology assessment of concentrator solar arrays.

38380 (N—78-27539) **Cost of photovoltaic energy systems as determined by balance-of-system costs.** Rosenblum, L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1978. 14p. NTIS PC A02/MF A01.

The effect of the balance-of-system (BOS), i.e., the total system less the modules, on photo-voltaic energy system costs is discussed for multikilowatt, flat-plate systems. Present BOS costs are in the range of 10 to 16 dollars per peak watt (1978 dollars). BOS costs represent approximately 50% of total system cost. The possibility of future BOS cost reduction is examined. It is concluded that, given the nature of BOS costs and the lack of comprehensive national effort focussed on cost reduction, it is unlikely that BOS costs will decline greatly in the next several years. This prognosis is contrasted with the expectations of the Department of Energy National Photovoltaic Program goals and pending legislation in the Congress which require a BOS cost reduction of an order of magnitude or more by the mid-1980s.

38381 (N—78-27540) **Evaluation of glass resin coatings for solar cell applications. Final report.** Field, M.B. (Pantek International Corp., Lewistown, PA (USA)). Apr 1978. Contract NAS3-20958. 38p. NTIS PC A03/MF A01.

Using a variety of non-vacuum deposition techniques coatings were implemented on silicon solar cells and arrays of cells interconnected on Kapton substrates. The coatings provide both antireflection optical matching and environmental protection. Reflectance minima near 2% was achieved at a single wavelength in the visible. Reflectance averaging below 5% across the useful collection range was demonstrated. The coatings and methods of deposition were: (1) Ta2O5 spun, dipped or sprayed; (2) Ta2O5.SiO2 spun, dipped or sprayed; (3) GR908 (SiO2) spun, dipped, or sprayed. Total coating thickness were in the range of 18 to 25 micrometers. The coatings and processes are compatible with single cells or cells mounted on Kapton substrates.

38382 (N—78-28475) **Thermal vacuum life test of an MSDS solar array drive (MSDS No. 2). First 2 years of operation.** Gillies, J.; Watters, R.W. (National Centre of Tribology, Risley (UK). European Space Tribology Lab.). Dec 1977. Contract ESTEC-2584/75-MD. 47p. NTIS PC A03/MF A01.

Results concerning the first two years of thermal vacuum testing of a solar array drive are reported. The shaft is rotated at its normal speed of one revolution a day. A radiator surrounding the mechanism in the vacuum chamber is held at a constant temperature of 22.5 C, while the shaft temperature, measured at the top of the shaft inboard of the large shaft bearing, is charged at six monthly intervals so that it operates at either 10 C or 60 C. At the beginning of each cycle, thirty eclipse temperature cycles are carried out in which the shaft temperature is reduced from 60 C to 0 C in 72 minutes and returned to 60 C. A 7 year test period is envisaged. The mechanism until now operated within specification limits. The signal slip rings show an increasing level of electrical noise.

38383 (N—78-28601) **Basic mechanisms study for MIS solar cell structures on GaAs. Final report.** Fonash, S.J. (Pennsylvania State Univ., University Park (USA)). Mar 1978. Contract JPL-954525. 39p. NTIS PC A03/MF A01.

The solar cell structure examined is the MIS configuration on (n) GaAs. The metal room temperature oxide/(n) GaAs materials system was studied. Metals with electronegativities varying from 2.4 (Au) to 1.5 (Al) were used as the upper electrode. The thinnest

metallization that did not interfere with the measurement techniques (by introducing essentially transmission line series resistance problems across a device) was used. Photovoltaic response was not optimized.

38384 (N—78-30656) **Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report.** Naes, L.G. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Materials Sciences Lab.). Apr 1978. Contract JPL-954410. 50p. NTIS PC A03/MF A01.

The liquid transparent film-forming, fluorocarbon, Spraylon, a protective coating for terrestrial solar cell modules was evaluated. Two modules were completed and field tested. Problems developed early in the field testing which led to the shortened test period, specifically, lifting of the antireflection coating, followed in some areas by complete film delamination. It is believed that although these problems were certainly induced by the presence of the SPRAYLON film, they were not failures of the material per se. Instead, assembly procedures, module design, and cell coating quality should be evaluated to determine cause of failure.

38385 (N—78-30658) **SAMICS marketing and distribution model.** (Barry (Theodore) and Associates, Los Angeles, CA (USA)). Apr 1978. Contracts NAS7-100;JPL-954905. 109p. NTIS PC A06/MF A01.

A SAMICS (Solar Array Manufacturing Industry Costing Standards) was formulated as a computer simulation model. Given a proper description of the manufacturing technology as input, this model computes the manufacturing price of solar arrays for a broad range of production levels. This report presents a model for computing these marketing and distribution costs, the end point of the model being the loading dock of the final manufacturer.

38386 (N—78-30659) **Study of SEP solar array modifications. Final report.** Antonides, G.J. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA). Electrical Power Systems Dept.). 14 Jul 1978. Contracts NAS7-100;JPL-995070. 57p. NTIS PC A04/MF A01.

The feasibility of modifying the solar electric propulsion (SEP) 66 watt/kilogram, 12.5 kilowatt solar array blanket design to incorporate ultra-low mass blanket technology and to generate conceptual design data by modifying the SEP solar array design to 17.5kW power output was performed. Five modified designs were developed, which substituted present SEP solar array design components with one or more of 50 micrometers thick solar cells, 75 micrometers cell coverglasses, and a different blanket substrate developed by GE. A parametric analysis was performed to determine the solar array mast least weight and blanket tension required to maintain a minimum natural frequency of 0.04 Hz. The solar array wing assembly weights and power outputs were calculated, and preliminary cost estimates for flight hardware development, fabrication and qualification were made for each case studied.

38387 (N—78-30662) **Characterization of solar cells for space applications. Volume 2: electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature.** Downing, R.G.; Miyahira, T.F.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Aug 1978. Contract NAS7-100. 38p. NTIS PC A03/MF A01.

Electrical characteristics of Solarex 50 micrometer-thick N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature.

38388 (N—78-31531) **Measurements of material properties for solar cells. Final report, 7 February 1977—6 March 1978.** Castle, J.G. Jr. (Alabama Univ., Huntsville (USA). Dept. of Physics). Jul 1978. Contract NAS8-32398. 34p. NTIS PC A03/MF A01.

Measurements on two candidate materials for space flight are reported. The observed optical transmittance of aluminum films vapor deposited on fused quartz showed anomalously high transmittance thru 400 A and 600 A and showed an effective skin depth of 110 A in the latter part of the 1000 A thickness. KAPTON films are shown by their optical transmission spectra to have an energy gap for electron excitation of approximately 2.5 eV, which value depends on the thickness as manufactured. The resistance of KAPTON film to ionizing radiation is described by their optical spectra and their electron spin resonance spectra.

38389 (N—78-31585) **Additional thermal cycling tests on solar cell panel samples under vacuum conditions. Final report.** Ley, W.; Rehmann, K.V. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Inst. fuer Raumsimulation). Jan 1978. Contract ESTEC-2311/74. 87p. NTIS PC A05/MF A01.

The continuation of a comparative deep thermal cycling test on eight solar cell panel samples is described. The first test included 2500 cycles under vacuum conditions. It was decided to continue the tests for another 1000 cycles on four previously tested and three new solar cell panels. For 1000 temperature cycles (hot phase - maximum temperature +70 C; cold phase - minimum temperature -180 C) three flexible and four rigid solar cell panels were tested simultaneously. At room temperature the samples were investigated at predetermined intervals for optical, electrical, and mechanical differences. A short description of the test facility (for further details, see final report DLR-IB 353-77/178N18563) and a discussion of the obtained test results is given.

38390 (N—78-31954) **Outline of cost-benefit analysis and a case study.** Kellizy, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1978. 28p. NTIS PC A03/MF A01.

The methodology of cost-benefit analysis is reviewed and a case study involving solar cell technology is presented. Emphasis is placed on simplifying the technique in order to permit a technical person not trained in economics to undertake a cost-benefit study comparing alternative approaches to a given problem. The role of economic analysis in management decision making is discussed. In simplifying the methodology it was necessary to restrict the scope and applicability of this report. Additional considerations and constraints are outlined. Examples are worked out to demonstrate the principles. A computer program which performs the computational aspects appears in the appendix.

38391 (PB—283998) **Silicon schottky photovoltaic diodes for solar energy conversion. Final report, 1 June 1975—31 May 1978.** Anderson, W.A. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Electrical Engineering). Jul 1978. 72p. NTIS PC A04/MF A01.

A 12.2% Cr-MIS solar cell was fabricated on (100) p-type, single-crystal Si. An efficiency of 8.8% was recorded on Wacker polycrystalline Si. Surface-state density values range from 1.5 x 10 to the 11th power/sq cm-eV to 1.5 x 10 to the 13th power/sq cm-eV for MIS diodes on (100) single-crystal, Wacker polycrystalline, IBM ribbon, and EFG ribbon Si. These data correspond to Vsub oc = 0.25-0.60 V on similar photovoltaic cells. Columnar, 5-micrometer crystallites have been obtained on e-beam-deposited Si films having a 20-30 micrometer thickness. Rectification and photovoltaic response have been observed. Other studies include ellipsometry, Auger analysis, environmental effects, heating effects, optical design, antireflection coatings, radiation effects, and new sources of Si.

38392 (SAN—1286-4) **Amorphous-silicon solar cells. Annual report, July 1, 1976—June 30, 1977.** Carlson, D.E. (RCA Labs., Princeton, NJ (USA)). Sep 1977. Contract EY-76-C-03-1286. 117p. Dep. NTIS, PC A06/MF A01.

Amorphous-silicon solar cells have been fabricated with conversion efficiencies as high as 6% in AM1 sunlight. The best values of the open-circuit voltage, short-circuit current density and fill factor are 895 mV, 14.5 mA/cm^2, and 0.674, respectively. Pd-Schottky-barrier cells have shown no degradation in conversion efficiency after 9700 h of constant illumination of ~ 50 to 75 mW/cm^2, and p-i-n cells have remained stable after more than 23 months on the shelf. Discharge-produced a-Si used in efficient solar cells contains ~ 10 to 30 at. % of bonded hydrogen. Infrared absorption and photoluminescence measurements indicate that the films with the lowest defect densities are deposited at substrate temperatures in the range of 300 to 350°C. Hydrogen out-diffusion at higher temperatures apparently creates defect stages such as dangling bonds. Photoconductivity measurements and light-pulse experiments indicate electron and hole lifetimes of ~ 1 to 40 μs. Light-pulse experiments yield electron drift mobilities of ~ 2-5 x 10^{-2} cm^2/V-s and hole drift mobilities of ~ 6 x 10^{-4} cm^2/V-s. Both techniques find an electron trap ~ 0.20 to 0.25 eV below the conduction band and a hole trap ~ 0.35 to 0.40 eV above the valence band.

38393 **Chemical vapor deposition of spectrally selective surfaces for high-temperature photothermal conversion.** Seraphin, B.O. (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). *J. Vac. Sci. Technol.;* **16**: No. 2, 193-196(Mar 1979).

The surfaces intercepting the incident radiation in photothermal converters must satisfy three requirements. First, they must offer a spectral profile that is properly matched to the solar emission and thermal reradiation properties. Second, they must withstand elevated temperatures without harmful changes of their optoelectronic characteristics. Third, they must operate long enough to make the initial investment a reasonable economic proposition. Multilayer systems deposited by CVD offer attractive features. We report on an absorber—reflector tandem that satisfies all three requirements and is fabricated by a method easily expanded to large-scale economic manufacture. Although CVD technology is well developed for the fabrication of semiconductor devices, efforts to deposit the thin films used in solar energy converters are only in an early stage. A set of characteristic requirements makes it necessary to modify some aspects of existing technology. Attention must be paid to the optical and morphological properties of the deposit, and their dependence on the deposition parameters and the substrate. We discuss the

difficulties encountered and describe some preliminary solutions that establish the feasibility of the concept. The silicon absorber can be deposited in satisfactory quality, reducing free-carrier absorption at elevated temperatures to an acceptable level. The layer is protected on either side against diffusion, and mismatches of thermal expansion are neutralized. The highly reflective silver film is stabilized against morphological changes bound to occur under the conditions of the subsequent CVD of the absorber. Recent developments include the CVD of amorphous silicon absorbers of improved temperature stability, and reflector films made of molybdenum. Stacks have been successfully tested at temperatures in excess of 500 °C.

38394 Formation of thin Cu_2S (chalcocite) films using reactive sputtering techniques. Armantrout, G.A.; Miller, D.E.; Vindelov, K.E.; Brown, T.G. (Lawrence Livermore Laboratory, Livermore, California 94550). *J. Vac. Sci. Technol.;* **16**: No. 2, 212-215(Mar 1979).

Thin Cu_2S (chalcocite) films, which are of interest for solar cell fabrication, have been prepared using reactive sputtering techniques. The copper—sulfur system, which is multiphasic an polymorphic, is difficult to form in the orthorhombic chalcocite phase. This phase can be achieved by careful control of substrate temperature and the partial pressure of H_2S in the sputtering atmosphere. Sulfur-rich atmospheres produce the sulfur-rich Cu/sub x/S phases which are unsuitable for solar cell fabrication, whereas sulfur-lean atmospheres result in precipitated copper cones on the surface. Epitaxial chalcocite films have been formed on single-crystal CdS substrates. Charge transport studies in polycrystalline Cu/sub x/S films formed on polycrystalline CdS indicate minority carrier diffusion lengths of 100 nm which are adequate for solar cell operation. The sputtering parameters affecting film formation (H_2S concentration, substrate temperature and bias, and substrate material) have been studied and are discussed.

38395 Effect of grain boundaries on the performance of polycrystalline tunnel MIS solar cells. Singh, R.; Bhar, T.N.; Shewchun, J.; Loferski, J.J. (Electrical Engineering, Howard University, Washington, D. C. 20059). *J. Vac. Sci. Technol.;* **16**: No. 2, 236-239(Mar 1979).

Tunnel MIS solar cells utilizing polycrystalline semiconductors are an attractive alternative to conventional p—n junction devices for fabricating large-scale solar energy conversion arrays. The main effect of the grain boundaries in polycrystalline semiconductors is to reduce the lifetime of the minority carriers. Experimental work indicates that the potential barrier near the grain boundary has a very limited effect on the barrier height which, in turn, controls open-circuit voltage of the device. The collection efficiency depends upon the grain size of the crystallites, in addition to other device parameters. A simple description of the performance of polycrystalline MIS solar cells will be presented, based on the above mentioned electrical characteristics.

38396 Plan for flight evaluation of attitude stabilization and flexible solar array dynamics for the Communications Technology Satellite. Vigneron, F.R.; Millar, R.A. (Communications Research Centre, Ottawa, Ontario). pp 91-111 of Space and energy. Napolitano, L.G. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 26. International Astronautical Congress; Lisbon, Portugal (21 Sep 1975).

The Communications Technology Satellite (CTS) will be launched into synchronous orbit with a Thor Delta 2914 vehicle in early 1976. CTS is a joint program of the Canadian Department of Communications (DOC), the National Aeronautics and Space Administration (NASA), and the European Space Agency (ESA). The agreements between DOC and NASA formally identify several communications satellite systems technologies to be developed and flight tested in the course of the program, among which are a 3-axis stabilization system to maintain accurate antenna boresight pointing on a spacecraft with flexible appendages, and an extendible lightweight solar array with an initial power output greater than one kilowatt. Plan and the technical activity which is presently being implemented by the Department of Communications in conjunction with SPAR Aerospace Products Limited, University of Toronto Institute for Aerospace Studies, and Telesat Canada is described. The stabilization system and solar array are briefly described. Prelaunch analysis, ground test, and parameter determination are discussed. Basic uncertainties which require flight test validation are discussed, and corresponding flight test objectives are outlined. The flight instrumentation to be carried on CTS is described. A computer-based data processing system to be used to handle, distribute, and analyze the flight data, is described. The passive and active events to be monitored during the CTS mission are outlined and discussed.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 38309, 38320, 38322, 39555, 39651

38397 (COO—4577-5) Description of the University of Texas at Arlington Solar Energy Research Facility photovoltaic/thermal residential system. Darkazalli, G. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 16 Mar 1979. Contract EG-77-S-02-4577. 37p. Dep. NTIS, PC A03/MF A01.

The addition of a photovoltaic array to a solar-heated single-family residence at the University of Texas at Arlington permits the study of combined photovoltaic/thermal system operation. Equipment and construction details are presented.

38398 (DOE/JPL/954862—4) Development of a model and computer code to describe solar grade silicon production processes. Fourth quarterly report, July 1—September 30, 1978. Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Nov 1978. Contract NAS-7-100-954862. 12p. Dep. NTIS, PC A02/MF A01.

This program aims at developing a mathematical model, and a computer code based on this model, which will allow prediction of the product distribution in chemical reactors in which gaseous silicon compounds are converted to condensed-phase silicon. The reactors to be modeled are flow reactors in which silane or one of the halogenated silanes is thermally decomposed or reacted with an alkali metal, H_2 or H atoms. Because the product of interest is particulate silicon, processes which must be modeled, in addition to mixing and reaction of gas-phase reactants, include the nucleation and growth of condensed Si via coagulation, condensation, and heterogeneous reaction. Period mechanisms for the $SiCl_4$/Na and SiF_4/Na reaction systems were examined. Reaction schemes which include 25 elementary reactions were formulated for each system and run to test the sensitivity of the computed concentration and temperature profiles to the values given estimated rate coefficients. It was found that, for $SiCl_4$/Na, the rate of production of free Si is largely mixing-limited for reasonable rate coefficient estimates. For the SiF_4/Na system the results indicate that the endothermicities of many of the reactions involved in producing Si from SiF_4/Na cause this system to be chemistry-limited rather than mixing-limited. Work is continuing on the problems of inserting particle nucleation and coagulation models into the code and is started on obtaining a suitable boundary layer code.

38399 (RLO—78-5) Increased energy from biomass: 1985 possibilities and problems. Working papers for planners. (Department of Energy, Seattle, WA (USA). Region X). 1978. 202p. (CONF-7810132—). Dep. NTIS, PC A10/MF A01.

From Pacific Northwest Bioconversion workshop; Portland, OR, USA (24 Oct 1978).

Summaries, together with charts and data in some cases, of the talks given by panelists to the Conference are compiled. The first four sessions examined current agricultural and peat applications with emphasis on wood use. The resource base for agricultural wastes, peat, and wood was evaluated. In the fifth session the barriers and constraints on the use of biomass as an energy source were identified and some possible solutions suggested. The sixth session consisted of work groups on the production of gaseous and liquid fuels, utility applications of biomass and impacts, residential and small scale applications, and biomass supply systems. Extensive summaries were provided of the discussions of each work group; these included recommendations on private and public actions necessary to foster the use of biomass for energy. (JSR)

38400 Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978). 876p. (CONF-780889—).

From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).

The 45 papers presented at the conference are compiled. Individual abstracts were prepared for each. (JSR)

38401 Eucalyptus Energy Farms as a renewable source of fuel. Mariani, E.O. pp 29-38 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).

Since 1969, Marelco, Inc. has conducted studies on the technical and economical feasibility of establishing Eucalyptus Energy Farms on Southern California deserts to supplement the natural gas curtailment by the gas company to Imperial Valley industry. The concept was ahead of the times. The imposition of the 1973—1974 oil embargo emphasized the vulnerability of United States socio-economic system by its dependence on imported petroleum and petroleum products. The effect of this embargo resulted in the revival of the Eucalyptus Energy Farms concept recognizing the necessity for development of alternative and essentially internal renewable sources of fuel for our future energy needs. Supported by the United States Department of Energy, research was conducted to identify suitable regional areas within the United States where Eucalyptus Energy Farms could be located and appropriate Eucalyptus species selected for these areas.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 38308, 38310

PHOTOVOLTAIC POWER PLANTS

38402 (N—78-27538) **Evaluation of solar cells and arrays for potential solar power satellite applications. Final report.** Almgren, D.W.; Csigi, K.; Gaudet, A.D. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 31 Mar 1978. Contract NAS9-15294. 81p. NTIS PC A05/MF A01.

Proposed solar array designs and manufacturing methods are evaluated to identify options which show the greatest promise of leading up to the develpment of a cost-effective SPS solar cell array design. The key program elements which have to be accomplished as part of an SPS solar cell array development program are defined. The issues focussed on are: (1) definition of one or more designs of a candidate SPS solar array module, using results from current system studies; (2) development of the necessary manufacturing requirements for the candidate SPS solar cell arrays and an assessment of the market size, timing, and industry infrastructure needed to produce the arrays for the SPS program; (3) evaluation of current DOE, NASA and DOD photovoltaic programs to determine the impacts of recent advances in solar cell materials, array designs and manufacturing technology on the candidate SPS solar cell arrays; and (4) definition of key program elements for the development of the most promising solar cell arrays for the SPS program.

38403 (N—78-30475) **Ionosphere/microwave beam interaction study. Final report.** Gordon, W.E.; Duncan, L.M. (Rice Univ., Houston, TX (USA)). Jul 1978. Contract NAS9-15212. 53p. NTIS PC A04/MF A01.

The microwave beam of the Solar Power Satellite (SPS) is predicted to interact with the ionosphere producing thermal runaway up to an altitude of about 100 kilometers at a power density threshold of 12 mW/cm sq (within a factor of two). The operation of the SPS at two frequencies, 2450 and 5800 MHz, is compared. The ionosphere interaction is less at the higher frequency, but the tropospheric problem scattering from heavy rain and hail is worse at the higher frequency. Microwave signals from communication satellites were observed to scintillate, but there is some concern that the uplink pilot signal may be distorted by the SPS heated ionosphere. The microwave scintillations are only observed in the tropics in the early evenings near the equinoxes. Results indicate that large phase errors in the uplink pilot signal can be reduced.

38404 (N—78-31143) **Design, fabrication and testing of a CFA for use in the solar power satellite. Final report.** Brown, W.C. (Raytheon Co., Wayland, MA (USA). Microwave and Power Tube Div.). Aug 1978. Contract NAS3-20374. 152p. NTIS PC A08/MF A01.

A crossed field amplifier was designed to meet the performance objectives of high signal to noise ratio, an efficiency of 85%, a CW microwave power output of 5-8 kW, and a frequency of 2450 MHz. The signal to noise ratio achieved was better than 69 db/MHz in a 2000 MHz band centered on the carrier. High circuit efficiency of 97% and a sharp knee on voltage current characteristic were achieved. The basic problem of maintaining good transfer of heat to the external radiator while providing for adequate connections to input and output was solved. Maximum efficiency achieved was 70.5% and gain and power level were below objectives. An investigation of causes of reduced performance indicated the poor field pattern in the cathode anode interaction area of the tube was a major cause.

38405 **Satellite solar power station construction in space.** O'Neill, G.K. (Princeton Univ., NJ). pp 61-64 of Space and energy. Napolitano, L.G. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 26. International Astronautical Congress; Lisbon, Portugal (21 Sep 1975).

The feasibility of establishing manufacturing facilities in space is briefly discussed, and the production of satellite solar power stations at a space colony is examined. (WHK)

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 38349, 38403, 38404, 38405

38406 (N—78-30663) **Siting issues for solar thermal power plants with small community applications.** Holbeck, J.J.; Ireland, S.J. (Jet Propulsion Lab., Pasadena, CA (USA)). 20 Jul 1978. Contract NAS7-100. 49p. NTIS PC A03/MF A01.

Technologies for solar thermal plants are being developed to provide energy alternatives for the future. Implementation of these plants requires consideration of siting issues as well as power system technology. While many conventional siting considerations are applicable, there is also a set of unique siting issues for solar thermal plants. Early experimental plants will have special siting considerations. The siting issues associated with small, dispersed solar thermal power plants in the 1 to 10 MWe power range for utility/small community applications are considered. Some specific requirements refer to the first 1 MWe engineering experiment for the Small Power Systems Applications (SPSA) Project. The siting issues themselves are discussed in three categories: (1) system resource requirements, (2) environmental effects on the system, and (3) potential impact of the plant on the environment. Within these categories, specific issues are discussed in a qualitative manner. Examples of limiting factors for some issues are taken from studies of other solar systems.

CENTRAL RECEIVER

38407 (LBL—7841) **Small particle heat exchangers.** Hunt, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

A dispersion of small absorbing particles forms an ideal system to collect radiant energy, transform it to heat, and efficiently transfer the heat to a surrounding fluid. If the heated fluid is a pressurized gas, it can be passed through an expansion turbine to create useful mechanical energy. The most obvious application of this technique is its use in a solar collection system. In this case, the incoming sunlight is used to heat a compressed gas in an engine utilizing a Brayton cycle. The solar collection system may utilize high concentration as provided by a central receiver or parabolic dish, medium concentration from a linear collector, or possibly no concentration using a flat plate collector, if precautions were taken to reduce the heat losses. The same concept may be applied generally to non-solar heat exchangers. These may be of the type used to heat a gas from a combustion source, or in general as a gas to gas heat exchanger. The latter application may be limited to rather high temperature. Each of the above applications is discussed. First, a description of the concept is applied to a solar central-tower system. The general principles are described, including the optical and physical characteristics of the particles, the confinement of the gas-particle mixture, and the system considerations; the latter include the amount and type of particles, the receiver efficiency and the generation of the particles. The same considerations are reviewed for applications to linear trough and flat plate receivers. Finally, the use of small particles in non-solar heat exchangers is considered.

38408 (PNL—2810) **Heliostat reflective surface substrate characterization.** Gordon, N.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1978. Contract EY-76-C-06-1830. 29p. Dep. NTIS, PC A03/MF A01.

The purpose of the surveys and analyses are to provide background information and procurement specifications for materials which have potential application in heliostat construction. The work performed under the reflective surface substrates characterization and specification task is covered. The properties of foam core sandwich constructions are emphasized. The research studies reported were directed toward determining the relationship between viscoelastic deformation of the adhesive and deflection of the mirror module.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 38485

38409 (SAN—1608-4-2) **Technical and economic assessment of solar hybrid repowering. Final report.** (Public Service Co. of New Mexico, Albuquerque (USA)). Sep 1978. Contract EG-77-C-03-1608. 104p. Dep. NTIS, PC A06/MF A01.

Drawings are presented for the repowering project described in SAN—1608-4-1. Reeves Sation No. 2 was selected for study for repowering at 50 percent (25 MWe) using the 10-MW solar central receiver pilot plant preliminary design for Barstow, California. (WHK)

OCEAN THERMAL GRADIENT POWER PLANTS

38410 (ANL/OTEC—001) **Qualification of stainless steel for OTEC heat exchanger tubes.** LaQue, F.L. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 25p. Dep. NTIS, PC A03/MF A01.

The history of the AL-6X alloy is reviewed and its credentials as a candidate for use as tubing in Ocean Thermal Energy Conversion Heat Exchangers are examined. Qualification is based on results

of accelerated tests using ferric chloride for resistance to crevice corrosion and pitting, long-time crevice corrosion and pitting tests in natural sea water and anticipated resistance to attack by ammonia and mixtures of ammonia and sea water. Since the alloy has no natural resistance to fouling by marine organisms, it must be able to accomodate action to prevent fouling by chlorination or to remove it by mechanical cleaning techniques or appropriate chemical cleaning methods. The satisfactory behavior indicated by the various accelerated and long-time corrosion tests has been confirmed by excellent performance of several million feet of tubing in condensers in coastal power plants. Early evaluation tests demonstrated the need for proper heat treatment to avoid the presence of a sigma phase, which promoted severe pitting of some, but not all, specimens in tests in natural sea water. The available data qualify the AL-6X alloy as being a satisfactory alternate to titanium for tubes in OTEC heat exchangers.

38411 (ANL/OTEC-TM—1) **Comparative study of working fluids for OTEC power plants.** Ganic, E.N.; W[illegible] J. (Illinois Univ., Chicago (USA). Dept. of Energy Engineering). Jan 1979. Contract W-31-109-ENG-38. 48p. Dep. NTIS, PC A03/MF A01.

The effect of three different working fluids (ammonia, propane, and freon-114) on the size of OTEC heat exchangers is analyzed. Seven different combinations of shell-and-tube heat exchangers are considered. For each combination, a simple computer model of the OTEC power system is used to compare the three fluids. The comparison is made on the basis of A/W/sub net/, where A is the total heat transfer area (evaporator plus condenser) and W/sub net/ is the net power output of the plant. Overall, ammonia is shown to be the best fluid (i.e., it yields the lowest value of A/W/sub net/), although in some cases only by a small margin. The thermophysical property that gives ammonia its general superiority is its relatively high thermal conductivity. The report also discusses heat exchanger design problems associated with liquid entrainment and boiling liquid superheat.

38412 (COO—4300-7) **Compact heat exchangers for sea thermal power plants. Final technical progress report, May 1, 1977—March 31, 1978.** (Sea Solar Power, Inc., York, PA (USA)). 31 Mar 1978. Contract EG-77-C-02-4300. 76p. Dep. NTIS, PC A05/MF A01.

The investigative studies required to develop a low cost, high performance flat plate heat exchanger design suitable for sea thermal power plants are covered. The studies indicate that higher boiling transfer coefficients quoted in the literature can be attained in a flat plate exchanger. The study has examined the effect of various fouling rates. A cleaning concept is proposed that is simple, high speed and easy to operate without plant or exchanger shutdown during the cleaning process. The exchanger concept for both boilers and condensers is a low profile, mechanical assembled structure with no welding, soldering, or brazing required. The exchanger design has been evaluated for manufacturability and ease of shipping, installation, and maintenance in a power plant. A preliminary arrangement for exchangers of this construction in a full scale power plant has been examined to provide confidence that the design would be usable in such a plant. Computer programs have been written to optimize design conditions for boilers and condensers in a power plant, recognizing costs of exchangers, cost of warm and cold water, water pumping power and effect of cycle efficiency. After optimizing design conditions a conceptual design has been prepared for a test boiler and a test condenser, suitable for testing in the Argonne test facility. A detailed design for a smaller test unit has been prepared. The Argonne test element will use ammonia as the working fluid. The smaller test unit will use R-22.

38413 (PB—285781) **Economic and technical feasibility analysis of ocean thermal energy conversion. Final report.** (InterTechnology Corp., Warrenton, VA (USA)). 17 Feb 1977. 75p. NTIS PC A04/MF A01.

Although basic technical feasibility of ocean thermal energy conversion (OTEC) has been proven, all technical problems have not been solved. Important technical issues are biofouling of the evaporator heat exchanger, manufacturability of the system, platform stability, station reliability, and the use of output energy. Economic feasibility has not been proven. Several estimates agree that bus-bar cost of OTEC generated electricity should be about 2.5 cents/kWh, higher than current electrical generation costs but lower than costs projected for photovoltaic electrical generation.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 38349

38414 (TAC-STC—78-003) **Solar thermal components: a bibliography with abstracts. Quarterly update, July—September 1978.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1978. 79p. Univ. of New Mexico, Albuquerque, NM.

This bibliography covers the following subjects: material properties; flat plate collectors; heat pumps; coolers; heat exchangers; solar ponds; distillation; process heat, and irrigation pumps. It contains an author index and a keyword index. (MHR)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 38365

38415 (AD-A—058626) **Solar assisted heat pump study for heating of military facilities. Final report, July 1976-November 1977.** Beason, F.L.; Strother, L.W. (Dubin-Bloome Associates, New York (USA)). Jul 1978. Contract F08635-76-C-0276. 202p. NTIS PC A10/MF A01.

This study identified 21 generic solar assisted heat pump systems and subjectively evaluated them. The six most promising systems were evaluated in further detail. A complete objective analysis of the two most promising systems was then made to determine which could be most economical to install in a family housing unit at Little Rock Air Force Base, Arkansas. The system chosen was a solar hot water heating system in parallel with a water source heat pump. Preliminary drawings integrating this system into a family housing unit at Little Rock AFB were developed. The system selected had a 27-32 year pay back.

38416 (AED-Conf—78-270-002) **Window as a solar collector.** Kuenzel, H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Muenchen (Germany, F.R.)). 1978. 13p. (In German). (CONF-7809122—3). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 2. building physics congress on the occasion of the ISO/glass technical fair; Duesseldorf, F.R. Germany (28 Sep 1978).

The thermal requirements of buildings are influenced among others, by parameters that have often been disregarded until now, e.g., heat losses through the windows. It is shown that, in contrast to previous assumptions, the energy gain through windows can be a positive contribution to the overall energy balance of a house.

38417 (CONF-780337—P1) **Passive solar energy planning aid kit for building design architects and planners.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). 1978. Contract EM-78-C-01-4228. 97p. Dep. NTIS, PC A05/MF A01.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Portions of document are illegible.

Separate abstracts were prepared for each of the included papers. (MOW)

38418 (CONF-780337—P1, pp 4p, Book 1, Paper 1) **Passive systems for solar heating and cooling: historical perspective.** Yellott, J.I. (Arizona State Univ., Tempe). 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The concept of using orientation and architecture to accept warmth from the sun in winter while denying entrance to excessive sunshine in summer is very ancient. Egyptians, Greeks, Persians and Hindus all used the passive concept, as did the pre-Columbian Indians in North and South America. "Solar Cooling", as defined in the Heating and Cooling Demonstration Act of 1974, was pioneered by Harold Hay in 1967—1968 at the author's laboratory in Phoenix, AZ when he employed night sky radiation in spring and fall, supplemented by evaporation in mid-summer, to accomplish passive cooling in the Southwestern desert climate. Many versions of this concept are now in various stages of design and construction in Arizona and elsewhere.

38419 (CONF-780337—P1, pp 3p, Book 1, Paper 2) **Natural solar/microclimate/solid-state design.** Wright, D. 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Direct gain, natural (passive) solar structures have existed for centuries. Today we recognize that much of the success of these historical examples is due to applied microclimate design principles. The state of the art can be advanced by recognizing these microclimate influences and designing to optimize their potential. In the near future, appropriate materials technology will be developed for natural solar systems. Applications of these materials can lead to direct gain/solid state systems.

38420 (CONF-780337—P1, pp 5p, Book 1, Paper 4) **Barriers, advantages, and incentives for passive solar design.** Anderson, B.; Sullivan, P. 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

During the last few years, barriers and incentives studies on applications of solar heating and cooling have been directed primarily at the implementation of "active" systems. This paper presents an extensive list of barriers for passive which are classified into several categories and rated on a scale of 1 to 10 according to their level of importance. "Advantages" are those characteristics about passive solar design which, if sufficiently recognized and properly taken advantage of, could increase the rate and level of market penetration. Numerous advantages are rated on the same scale of 1 to 10 and listed in their order of priority. Incentives cover all programs, activities, legislation, regulations and so forth designed to hasten the implementation of passive solar design.

38421 (CONF-780337—P1, pp 6p, Book 2, Paper 1) **Beyond passive design: toward an integrative conservation technology.** Watson, D. (Yale School of Architecture, New Haven, CT). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A review of hybrid active and passive concepts is presented. Some payback time calculations are described for various systems. (MOW)

38422 (CONF-780337—P1, pp 5p, Book 2, Paper 2) **Model design process for passive solar architecture.** Levin, D. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

To integrate the notions of natural (passive) space conditioning into architectural practice, a design procedure is necessary. Through manipulations of the inputs into a process, a well-integrated, architecturally and thermally efficient building will result. Three case studies, in three unique microclimates, illustrate the results.

38423 (CONF-780337—P1, pp 5p, Book 2, Paper 3) **Solar atrium: a hybrid solar heating and cooling system.** Ueland, M. (Ueland and Junker, Architects and Planners, Philadelphia, PA); Larson, D.C. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The solar atrium was designed and will be constructed for testing within a demonstration model single family residence. The atrium and residence will be instrumented and monitored to obtain data on insulation, temperatures and fuel costs over a full year heating and cooling season. Life cycle costs will be generated, including costs of installation, operation and financing. Cost-effectiveness will be measured by comparing the life-cycle costs generated for the experimental model with a similar residence of conventional design without the solar atrium. Comparisons will also be made with other existing residences and with models described in other published studies.

38424 (CONF-780337—P1, pp 4p, Book 2, Paper 4) **Passive solar house based on balanced direct gain heating and night ventilation cooling.** Cooper, P.; Haggard, K.; Niles, P. (San Luis Obispo Solar Group, CA). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A house designed to provide direct gain heating and night ventilation cooling for the inland area of the central coast of California is described. Thermal control was provided using traditional materials and building construction techniques for the area, only slightly modified for the passive solar design. A simplified Direct Gain thermal prediction model was used to develop the design, and this model will in turn be evaluated through study of the building's performance.

38425 (CONF-780337—P1, pp 7p, Book 3, Paper 1) **Third overlay.** Quigley, R.W.; Keniston, S. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This paper documents the architectural design implications of considering serious energy conservation at the programming stage of large building design. The project being examined was an award of merit winner (one of six finalist schemes) in the recent competition to design an energy efficient state office building in Sacramento, California. The effort was a joint venture of Gluth and Quigley Architecture and Energy Managements Consultants, Inc. It consisted of 40 housing units, a cafeteria, auditorium, shops and 240,000 ft^2 of offices in 2 buildings, covering 1 1/2 blocks near the Sacramento mall. Every aspect of resource conservation, recycling and alternative energy production was considered in terms of cost effectiveness and quality of environment.

38426 (CONF-780337—P1, pp 7p, Book 3, Paper 2) **Energy efficient office building for the state of California.** Corson, B.A. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The thermal storage potential of a reinforced concrete structure and a large rockbed, both cooled with night air, are used in conjunction with a tight building skin, operable exterior sunshades and greatly reduced artificial lighting to produce an energy efficient office building for the State of California. This building is projected to require less than 20% of the energy consumed annually by existing state office buildings. The rockbed is used for heat recovery and can be operated to reduce the demand on the mechanical chilling equipment by 75%. It is estimated that the night ventilation of the structure will meet 65% of the total cooling while the rockbed will provide an additional 25%. Total gross energy consumption for the building is estimated to be 64,300 Btu per square foot per year.

38427 (CONF-780337—P1, pp 5p, Book 3, Paper 3) **Office building for an era of transitions: application of the skytherm system of passive heating and cooling to a moderate density office building.** Haggard, K. (California Polytechnic State Univ., San Luis Obispo); Pohl, J.; Cooper, P. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

An entry in California's State Energy Efficient Office Building Competition which utilized roof ponds for heating and cooling is described. Summarized briefly are the architectural, thermal, and structural characteristics of this entry. More attention is given to the description of social and urban design implications and natural lighting since these have received less attention in solar-oriented buildings to date.

38428 (CONF-780337—P1, pp 6p, Book 3, Paper 4) **Daylighting design for the Sacramento State Office Building Competition.** Stenhouse, D.S. (Energy Management Consultants, Inc., Los Angeles, CA); Wolf, C.H. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

For the building designer, daylighting is a powerful tool for passive energy conservation and therefore deserves primary consideration in the initial schematic and preliminary design stages of building design. The principles of daylighting became an overriding concern in space planning, massing of building elements, the choice of structural and artificial lighting systems, and in relevant details of the envelope for solar gain considerations.

38429 (CONF-780337—P2) **Passive solar energy planning aid kit for the business community and general public.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). 1978. Contract EM-78-C-01-4228. 124p. Dep. NTIS, PC A06/MF A01.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).
Portions of document are illegible.
Separate abstracts were prepared for each of the included papers. (MOW)

38430 (CONF-780337—P2, pp 3p, Book 1, Paper 1) **Solar consumer: living in a glass house.** Balcomb, S. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The performance and environment of a passive solar home; and some possible avenues of approach to consumer education.

38431 (CONF-780337—P2, pp 5p, Book 1, Paper 3) **Model design process for passive solar architecture.** Levin, D. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

To integrate the notions of natural (passive) space conditioning into architectural prractice, a design procedure is necessary. Through manipulations of the inputs into a process, a well-integrated, architecturally and thermally efficient building will result. Three case studies, in three unique microclimates, illustrate the results.

38432 (CONF-780337—P2, pp 5p, Book 2, Paper 1) **Hull residence: a passive solar hybrid system.** Frerking, M. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The Hull Residence in Prescott, Arizona, attempts to combine a passive, direct/indirect gain system, with an active air system. An integrated greenhouse serves as collector/storage, with pancake rock bed for active air storage.

38433 (CONF-780337—P2, pp 4p, Book 2, Paper 2) **Direct gain passive design: delap residence.** Lambeth, J. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A high school teacher and his wife--on a limited budget--requested a low-cost, high energy efficient house. The resulting design and its analysis follow.

38434 (CONF-780337—P2, pp 7p, Book 2, Paper 3) **Soldyne house.** Starr, G. (Soldyne, Burlingame, CA); Melzer, B. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A simple direct solar home was built in Davis utilizing the slab as the primary thermal mass. Temperature data was collected daily for a full year under live-in conditions. A detail analysis of the slab is presented.

38435 (CONF-780337—P2, pp 3p, Book 2, Paper 4) **Sunearth home.** Shippee, P. (Colorado Sunworks, Boulder, CO). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A description of an earth-covered passive solar heated and cooled home built in Longmont, Colorado, is given. This home features massive water-filled drum walls, Beadwall, concrete structure, one-foot thick earth cover with full berms, passive tank water heater (using Trombe--Meinel cusp reflecter), 45° skylight wells, and full five-year performance documentation by the National Bureau of Standards.

38436 (CONF-780337—P2, pp 4p, Book 2, Paper 5) **Passive heated residences.** Lasar, S. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This paper describes the passive solar heated home designed and built by Stephen Lasar and Design Associates in Western Connecticut. It also describes some of the experiences of living with these designs and some data.

38437 (CONF-780337—P2, pp 2p, Book 2, Paper 6) **Levine house.** 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Drawings of the house are given along with a brief description of the house and heating and cooling requirements. (MOW)

38438 (CONF-780337—P2, pp 6p, Book 2, Paper 8) **Lindeberg residence: a DOE funded hybrid solar house.** Pfister, P.J. (Architectural Alliance, Minneapolis, MN). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The following paper summarizes the design and development of the Lindeberg residence, a 2100 square foot residence to be constructed near Minneapolis, Minnesota. The residence will store solar energy collected through 350 net square feet south facing windows and skylights in a precast concrete air floor. Additional thermal storage is provided in a rock storage bin located within the thermal envelope of the living space. An interior solar collector is used to boost the temperature storage range and feeds directly into the rock storage bin. Movable window insulation will cover large south facing windows at night, and overhangs provide natural summer shading of glazing.

38439 (CONF-780337—P2, pp 5p, Book 2, Paper 9) **Hybrid solar system in Los Alamos, New Mexico.** Zwart, G.W. (Shepley, Bulfinch, Richardson and Abbott, Boston, MA). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This project represents an effort to provide the basic housing needs of a family of four, to take advantage of a spectacular site and to make the sun the major source of heating in winter without overheating in summer and without the high costs associated with "active" solar systems. Completed in July of 1977, this is basically a passive house with an "active" circulation and storage system. The system results in reduction of the peak highs and lows of the temperature curve which are common to many passive designs.

38440 (CONF-780337—P2, pp 2p, Book 2, Paper 10) **Lumsdaine solar house.** Lumsdaine, E.; Lumsdaine, M. (New Mexico State Univ., Las Cruces). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The design objectives of this home takes advantage of the desert climate, maximum passive solar heat gain, few controls and no auxiliary heating or cooling. A description of the home is given. (MOW)

38441 (CONF-780337—P2, pp 3p, Book 2, Paper 11) **Harrison residence: Placitas, New Mexico.** Harrison, D.C. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The house is an enneaconahedron dome structure composed of two different diamond shaped panels. The solar collectors consist of 600 ft^2 of south facing beadwall panels. The heat storage system consists of 23,000 lbs of water. The performance of the system is described. (MOW)

38442 (CONF-780337—P2, pp 5p, Book 2, Paper 12) **Knowing and loving, and never knowing: two houses.** Scully, D. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Two houses are compared, both making the best use of passive solar they can in their own particular situations. The Cook House uses water tubes as the thermal mass partitions between rooms and thermal zones. Rigid insulating shutters and Beadwall are used. The Stylecraft Colonial Solar House uses an active solar system for the thermostat-type control and makes the best possible use of passive solar heat gain, in both direct and indirect ways. Here the passive is more subtle than in the Cook House, in effect unknown to the occupant. The passive system requirements will be discussed for their effect on design and thermal performance in each building, as will thermal sizing in relation tc glazed area and heat loss.

38443 (CONF-780337—P2, pp 2p, Book 2, Paper 13) **Gayland B. Witherspoon residence, Central, S.C.** 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A brief description of this home featuring passive solar heating is given. Some technical data are described. (MOW)

38444 (CONF-780337—P2, pp 5p, Book 2, Paper 14) **House at Crooked Creek. Direct gain passive solar design in an extreme climate.** Schiff, M. (Southlite Design, Dubois, WY). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The Schiff residence was built during July 1976—October 1977 in Dubois, Wyoming, elevation 7500 ft. The house uses three large clerestories facing south. Some construction and performance details are given. (MOW)

38445 (CONF-780337—P2, pp 7p, Book 3, Paper 1) **Noti solar greenhouse, performance and evaluation.** Mazria, E. (Martix, Albuquerque, NM); Baker, S.; Hoff, E.; Jenkins, D.; Van Duyn, K. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A passive solar heated greenhouse situated in the Willamette Valley (Noti, Oregon), was designed and built in the Spring of 1976. The greenhouse has been monitored for one year by the University of Oregon (closely for 6 weeks in January and February 1977), and is performing as expected. It has operated through its first winter without any additional heating source but the sun. This project demonstrates the feasibility of passive systems as a major heating source for buildings in the Pacific Northwest, an area thought unsuitable for solar energy utilization.

38446 (CONF-780337—P2, pp 5p, Book 3, Paper 2) **Hybrid solar greenhouse at Cate farm.** Troia, E.; Atlas, A.; Pascale, R. (Inst. for Social Ecology, Plainfield, VT). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A hybrid solar greenhouse provided the setting for an experiment in defining the microclimatic characteristics of the building. The building was closely monitored from January 6 to February 14, and information pertaining to heat gain/loss characteristics was compiled. Heat gain was measured at 11.2% active, 11.7% passive, and 77.1% supplied by wood. Concomitant with a technological analysis, a clear, critical social evaluation is necessary. A position statement concerning the immediate and direct application of solar energy as an ecological technology is discussed.

38447 (CONF-780337—P2, pp 2p, Book 3, Paper 3) **Passive solar heated house and greenhouse on Cape Cod, description and performance.** Williams, P.F. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This paper describes a house using a greenhouse together with Kalwall storage tubes as collectors and storage. It includes results of two months performance.

38448 (CONF-780337—P2, pp 2p, Book 3, Paper 4) **Solar heated greenhouse.** Schiff, M.; Bauch, T.D. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The greenhouse is a well insulated shell wih only the south wall glazed with Beadwall. The interior of the north wall is aluminized so as to focus the incident energy into a water trough at the base of the north wall. The performance of the system is briefly discussed. (MOW)

38449 (CONF-780337—P2, pp 2p, Book 3, Paper 5) **Rocky Mountain greenrooms.** Franta, G.E. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

The use of attached greenhouses in the Rocky Mountains is discussed. The Smith—Hite studio near Aspen, Colorado integrates a 600 ft^2 weaving studio with a 224 ft^2 greenroom. The greenroom provides both solar heat collection and space for food production. The house is described. (MOW)

38450 (CONF-780337—P2, pp 7p, Book 2, Paper 7) **Kelbaugh House: recent performance.** Kelbaugh, D. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

This paper deals with the Kelbaugh House, a passive solar home built in 1974 in Princeton, N.J., which is heated by a Trombe wall (Fig. 1) and greenhouses. The following topics are discussed: early problems and their resolution; performance during the winter of 1976-1977; monitoring by LASL; temperature profiles; and a simple design method for calculating heat gain and heat loss through a Trombe wall.

38451 (CONF-780337—P3) **Passive solar energy planning aid kit for solar energy systems engineers.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). 1978. Contract EM-78-C-01-4228. 106p. Dep. NTIS, PC A06/MF A01.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).
Separate abstracts were prepared for 11 of the included papers. The remaining two papers appeared previously in ERA. (MOW)

38452 (CONF-780337—P3, pp 5p, Book 1, Paper 2) **Prediction of performance of a minimal storage passive solar house: the Crosley home.** Shapiro, A.M. (National Center for Appropriate Tech., Butte, MT). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A non-computer method of predicting annual performance of a passive house with minimal heat storage is presented. The method is shown to approximate the fuel consumption for the 1976—1977 winter.

38453 (CONF-780337—P3, pp 6p, Book 1, Paper 4) **Quantitative method for the design of buildings with comfortable microclimates by passive control of solar effects.** Agha, M.F. (Rogers, Butler, Burgun and Shahine, Architects, New York, NY); Lior, N.; McCleary, P. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A simple and inexpensive computer-aided method for designing buildings in which the climate is controlled passively, i.e., without mechanical systems, is described. The compter program determines the maximal and minimal interior temperatures, based on inputs which include building shape, dimensions, thermophysical properties of construction materials, and outdoor transient temperature and insolation. The program includes a comprehensive method for the determination of shaded areas on the building and surrounding ground, and of their influence on internal temperatures. This method has been used to study the courtyard house as a specific example of a self-shading building used in hot arid zones. The effects of building orientation, courtyard dimensions, building height, wall thickness, color, materials, and ground cover, on the interior temperature limits were computed.

38454 (CONF-780337—P3, pp 5p, Book 1, Paper 5) **Simple direct gain passive house performance prediction model.** Niles, P.W.B. (California Polytechnic State Univ., San Luis Obispo, CA). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Simple design aids are proposed that allow determination of the temperature cycle inside of direct-gain solar heated buildings for both convectively and radiatively coupled systems. Design curves, giving the performance as a function of the major environmental and building parameters, are included for the case of heavyweight concrete storage.

38455 (CONF-780337—P3, pp 6p, Book 1, Paper 6) **Design tool to assess room air temperatures of a passively heated space.** Lebens, R.M. (Byldan Partnership, Arlington, MA). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Despite the publicity and success of passive solar heated projects, their design concepts have not been widely adopted. This is due largely to a lack of engineering criteria. The ability to analyze the storage of solar energy, and its effect on the room air temperature, is not within the grasp of the building designer. The aim of this paper is to help remedy this situation for the direct heat transfer type of passive solar heated building. A design method is presented for assessing the daily room air temperature fluctuation of a passively heated space under various climatic and architectural conditions.

38456 (CONF-780337—P3, pp 8p, Book 2, Paper 1) **South-wall heating system for a commercial building employing tilt-up concrete construction.** Whitehouse, H.T.; Bagshaw, D.P. (Pacific Sun, Inc., Menlo Park, CA). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

An industrially based Trombe-type wall is currently under construction in Santa Clara, California. The solar absorber is comprised of a modified tilt-up concrete wall common to many commercial and industrial buildings. This paper focuses on design considerations and a computer analysis undertaken to predict transient thermal performance.

38457 (CONF-780337—P3, pp 5p, Book 2, Paper 2) **Trombe wall with phase change storage material.** Telkes, M. (American Technological Univ., Killeen, TX). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Trombe wall structures are being developed using a polyhedral wall that transmits more than 60% solar energy and at the same time has the same insulating value as a one inch thick foamed plastic. Heat-of-fusion type phase change, eutectic salt hydrate materials are placed behind the polyhedral wall. This inner storage wall is encased into black-surfaced heat exchangers, to absorb solar radiation, melting salt hydrates and storing thermal effects at a nearly constant temperature. Concrete walls 20 inches thick (50 cm) can be replaced with one inch (2.5 cm) thick salt-hydrate-filled heat exchangers, weighing about 12 pounds per square foot of solar absorbing area, capable of storing up to 1200 Btu, equal to the transmitted solar energy on clear days.

38458 (CONF-780337—P3, pp 5p, Book 2, Paper 3) **Comprehensive approach to window design for energy conservation.** Hastings, S.R. (National Bureau of Standards, Washington, DC). 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Six categories of design strategies to improve the energy performance of windows are presented. These design strategies are evaluated by their ability to improve one or more of six possible energy control functions windows can perform. An example strategy is selected from each category to illustrate how substantially a window's performance can be improved. In designing and subsequently evaluating a window one should consider the performance of the window in concert with various design strategies and the performance of a given solution should be considered relative to all six possible energy control functions.

38459 (CONF-780337—P3, pp 8p, Book 2, Paper 5) **Weather responsive building skins: concepts and configurations.** Wellesley-Miller, S. 1978.
From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

Transparent insulations, solar modulators and isothermal heat storage systems lay the basis for opaque and transparent weather responsive building skins. The performance properties of these solar materials are reported and a number of use configurations are explored.

38460 (CONF-780337—P3, pp 7p, Book 3, Paper 1) **Testing and simulation of passive solar systems.** Duncan, I.P. (Univ. of Pennsylvania, Philadelphia); Prowler, D. 1978.

From 2. national passive solar conference; Philadelphia, PA, USA (16 Mar 1978).

A test room, similar to those built at Los Alamos Scientific Laboratory, has been constructed on the roof of the Moore School of Electrical Engineering at the University of Pennsylvania. This test room is under controlled conditions so as to investigate the performance of these systems and the effects of selected parameters under the climatic conditions experienced in the Mid-Atlantic Region of the U.S. Concurrent with this experimental analysis, a simple, interactive computer simulation program is being developed using APL. Due to lack of funds the test room was not completed until the end of February 1978, and the results presented are only from preliminary equipment. These show that the test room is performing as predicted. The computer simulation program, however, has been run using climatic data made available by the Philadelphia Electric Company for a site in King of Prussia. Results to date for a simple isothermal water wall simulation compare favorably with those found by Los Alamos Scientific Laboratory for the same system but using Albuquerque climatic data.

38461 (CONF-7709179—1) **Design concepts for solar heating in a Mediterranean climate.** Schneider, M.; Berger, X.; Bourdeau, L.; Jaffrin, A.; Sylvain, J.D. (Observatoire de Nice, 06 (France)). 1977. 27p. (In French). Dep. NTIS (US Sales Only), PC A03/MF A01.

From International study workshop on solar heating in residences; Liege, Belgium (12 Sep 1977).

Solar heating is often designed in a similar way to classical central heating. The consequence is a very high cost which can only be reduced by using a calorific fluid at a lower temperature than is customary, improved architectural design and a further research into new passive heating methods. The collection area and storage volume necessary to obtain good solar efficiency were computed in a Mediterranean climate. Emphasis is put on large thermal inertia which is best achieved by using the latent heat of materials. The result of an experiment performed with salt hydrates is most promising but many problems of time instability have still to be solved.

38462 (DOE/NASA/CR—161151) **Design package for programmable controller and hydronic subsystem.** (Sunkeeper Control Corp., Andover, MA (USA)). Mar 1979. Contract EX-76-A-29-1037. 28p. Dep. NTIS, PC A03/MF A01.

This report contains information used in the evaluation of design of Sunkeeper Control's electronic controllers and hydronic packages. Some of the information includes system performance specification, design data brochure, drawings, and qualification and acceptance test procedures.

38463 (DOE/NASA/CR—161190) **Installation package for the solaron solar subsystems.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1979. Contract EX-76-A-29-1037. 64p. Dep. NTIS, PC A04/MF A01.

This package contains information that is intended to be a guide for installation, operation, and maintenance of the various Solaron Solar Subsystems. The subsystems consist of the following: collectors, storage, transport (air handler) and controller for heat pump and off-peak storage. Two prototype residential systems have been installed at Akron, Ohio, and Duffield, Virginia.

38464 (DOE/NASA/CR—161192) **System design package for solar heating and cooling system installed at Akron, Ohio.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1979. Contract EX-76-A-29-1037. 74p. Dep. NTIS, PC A04/MF A01.

Portions of document are illegible.

This package contains information used to evaluate the design of Solaron's solar heating, cooling, and domestic hot water system. A conventional heat pump provides summer cooling and back-up heating (when solar energy is not available). Included in the package are such items as the design data brochure, system performance specification, system hazard analysis, spare parts list, and detailed design drawings. A Solaron solar system is installed in a single-family dwelling at Akron, Ohio, and at Duffield, Virginia.

38465 (DOE/TIC—10071) **Solar heating and cooling of buildings (SHACOB) commercialization report. Part B. Analysis of market development. Volume II. Technical report. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Sep 1977. 88p. Dep. NTIS, PC A05/MF A01.

The SHACOB Commercialization Model is designed to gauge the impacts of selected Federal incentive programs to encourage the development of solar energy equipment for hot water heating, space heating and space cooling in residential and commercial buildings. The model has been implemented as a FORTRAN program and is presently running on the FEA computer system. It is used via the SUPER WYLBUR data management system at FEA. Some modeling results are presented.

38466 (HCP/CS—4113-2) **Passive solar design: a survey of monitored buildings.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EG-77-C-01-4113. 360p. Dep. NTIS, PC A16/MF A01.

This survey consists of collected articles reporting the thermal performance of buildings using passive solar techniques, plus a matrix tabulating the information contained in the reports, and a verbal summary of the results. Most of the articles have been published previously; additional information has been gathered from owners and designers and is attached as an addendum to the articles.

38467 (HCP/CS—4113-3) **Passive solar design. An extensive bibliography.** (AIA Research Corp., Washington, DC (USA)). Dec 1978. Contract EG-77-C-01-4113. 210p. Dep. NTIS, PC A10/MF A01.

The bibliography is organized into two parts: by subject and by author. Part A is divided into twenty-one subject matter categories each with entries listed alphabetically according to the title. Part B is alphabetically listed according to author. The information given about each entry is not as complete as in many bibliographies, but is sufficient for most practitioners or researchers to locate the documents desired. The bibliography includes materials included in major computerized data banks as of January 1978. In the interest of completeness, the proceedings of the Second National Passive Conference have also been included. Later materials should be separately researched.

38468 (HCP/M4113—01) **Passive solar design: a short bibliography for practitioners.** (AIA Research Corp., Washington, DC (USA)). Oct 1978. Contract EG-77-C-01-4113. 28p. Dep. NTIS, PC A03/MF A01.

The purpose of this bibliography is to provide design practitioners with a core of sources for informing themselves about passive design. It should be used as a basic resource. It is intended to give practitioners ready access to good materials on topics relating to the use of passive heating and cooling techniques. Rather than listing all articles, it provides a substantial sampling of the information available at the time of publication.

38469 (IS-M—192) **Earth-integrated direct gain residence using concrete cored slab.** Block, D.A.; Hodges, L. (Iowa State Univ. of Science and Technology, Ames (USA); Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 13p. (CONF-790118—5). Dep. NTIS, PC A02/MF A01.

From 3. national passive solar conference; San Jose, CA, USA (11 Jan 1979).

An earth-integrated direct gain residence designed for central Iowa is now under construction in Ames. The house has two 44-ft by 25-ft levels, is sunk into the ground, is bermed on the north, east, and west sides, and has 500 sq. ft. of southern glazing. The main thermal storage is the floor between the two levels. It consists of 8-inch-thick concrete cored slab, which has long cylindrical holes running its length, and a 2-inch topping. The cores will serve as supply-return ducts for a forced air system. A small fan will pull air through the cores from south to north by day and in the opposite direction by night. The slab will radiate warmth up and down to the two levels. The house is calculated to be about 85 percent solar and require 6 million BTU auxiliary in a typical 6800-degree-day heating season.

38470 (LBL—7811) **Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings.** Goldstein, D.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 347p. Dep. NTIS, PC A15/MF A01.

This paper describes an application of the fundamental methods of physics to solve a problem of environmental and economic interest: the description of the thermal performance of passive solar buildings. Such a description is of great practical interest to building designers; however, this paper is not intended to be of use to architects and engineers in its present form. Its intention is to provide a theoretical basis for understanding passive solar buildings; further effort is needed to develop rules of solar engineering.

38471 (LBL—8814) **Classification scheme for the common passive and hybrid heating and cooling systems.** Holtz, M.J.; Place, W.; Kammerud, R.C. (Solar Energy Research Inst., Golden, CO (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979. Contract W-7405-ENG-48. 9p. (CONF-790118—6). Dep. NTIS, PC A02/MF A01.

From 3. national passive solar conference; San Jose, CA, USA (11 Jan 1979).

A systematic nomenclature and classification scheme is proposed for passive space heating and cooling systems. It is based upon

the mode of energy transport to and from the space and the environmental resource from which the energy is received or to which it is discharged. A number of passive and hybrid space heating and cooling systems are characterized.

38472 (N—78-28613) **Solar heating and cooling system design and development. Status summary through December 1977.** (General Electric Co., Philadelphia, PA (USA)). 6 Apr 1978. Contract NAS8-32092. 26p. NTIS PC A03/MF A01.

Application surveys and performance studies were conducted to determine a solar heating and hot water configuration that could be used in a variety of applications, and to identify subsystem modules that could be utilized in a building block fashion to adapt hardware items to single and multi-family residential and commercial systems. Topics discussed include: subsystem development for the solar collectors, controls, other components, energy management module, and the heating system configuration test. Operational tests conducted at an Illinois farmhouse, and a YWCA in Spokane, Washington are discussed.

38473 (N—78-30202) **Corrosion inhibitors for solar heating and cooling systems.** Humphries, T.S. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Aug 1978. 15p. NTIS PC A02/MF A01.

Inhibitors which appeared promising in previous tests and additional inhibitors including several proprietary products were evaluated. Evaluation of the inhibitors was based on corrosion protection afforded an aluminum-mild steel-copper-stainless steel assembly in a hot corrosive water. Of the inhibitors tested two were found to be effective and show promise for protecting multimetallic solar heating systems.

38474 (N—78-31539) **Greenbelt community project: solar energy retrofit for a multi-family dwelling.** Hymowitz, E.W.; Hannemann, R.J.; Millman, L.L.; Pownell, J.E. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1978. 133p. NTIS PC A07/MF A01.

A cooperative project was initiated between Goddard Space Flight Center and the nearby community of Greenbelt, Maryland. The purpose was to design, install and operate an experimental solar heating system on a group of four tandem town houses. The system was successfully developed and is operating. A description is given of the design, installation, system operation and performance as well as the important considerations for judging the economic feasibility of solar heating systems.

38475 (NTIS/PS—78/1014) **Solar space heating and air conditioning. volume 2. 1976-august, 1977 (citations from the NTIS data base). Report for 1976-August 1977.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 247p.

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and cooling systems for residential buildings. Included are a few abstracts of reports on solar energy as a national energy resource; solar energy research program alternatives; and social, environmental, and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. (This updated bibliography contains 241 abstracts, none of which are new entries to the previous edition.)

38476 (NTIS/PS—78/1015) **Solar space heating and air conditioning. volume 3. September, 1977-september, 1978 (citations from the ntis data base). Report for September 1977-September 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 96p.

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and cooling systems for residential buildings. Included are a few abstracts of reports on solar energy as a national energy resource; solar energy research program alternatives; and social, environmental, and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. (This updated bibliography contains 90 abstracts, all of which are new entries to the previous edition.)

38477 (NTIS/PS—78/1017) **Solar space heating and air conditioning. volume 3. September, 1977-September, 1978 (citations from the Engineering Index data base). Report for sep 77-sep 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 103p.

Studies from worldwide literature on the use of solar energy to heat and cool buildings are discussed, with emphasis on the heating and cooling of residential buildings and schools. Design, technical feasibility, economics, and performance simulation studies are cited. Abstracts pertaining to solar assisted heat pump systems and assessment of solar heated Rankine cycle cooling are included. (This updated bibliography contains 97 abstracts, all of which are new entries to the previous edition.)

38478 (NTISUB/D—452) **Solar thermal heating and cooling, 1978. Quarterly reports.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. vp. New Mexico Univ., Albuquerque.

This bibliographic series cites and abstracts the literature and technical papers on the heating and cooling of buildings with solar thermal energy. The quarterly volumes are divided into ten categories: Space Heating and Cooling Systems, Space Heating and Cooling Models, Building Energy Conservation, Architectural Considerations, Thermal Load Computations, Thermal Load Measurements, Domestic Hot Water, Solar and Atmospheric Radiation, Swimming Pools, and Economics.

38479 (PB—284138) **A socio-economic and marketing study for a Puerto Rico Economic Development Administration (fomento) solar cooled factory in Puerto Rico. Final report.** (Puerto Rico Dept. of Natural Resources, San Juan). Apr 1978. 50p. NTIS PC A03/MF A01.

The report discusses the economics of the proposed industrial solar air conditioning system and the range of industrial buyer/specifier criteria used in purchasing solar air conditioning systems.

38480 (SAND—78-0681) **Composition stability and degradation products of selected materials for solar heating and cooling.** Arnold, C. Jr.; Trujillo, R.E. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

The composition, stability and thermal degradation products of a variety of structural plastics, heat transfer fluids, thermal storage media and sealants, which have been proposed for use in solar heating and cooling applications, were either defined generically by analysis or obtained by surveying the literature. This information will be used to aid in the assessment of the environmental impact of these materials. By gas chromatography-mass spectrometry (GC-MS), β-phenylnaphthylamine, a suspected carcinogen, was tentatively identified as a component in the heat transfer fluid, UCON. In addition, aromatic components which might be toxic were detected in all of the heat transfer fluids that were derived from petroleum sources. By TGA (thermogravimetric analysis), it was found that polysulfide, Neoprene, poly(vinyl chloride) and poly(vinyl fluoride) were the least stable solar heating and cooling materials. In the event of a solar system failure, these materials would be expected to thermally degrade and evolve such toxic substances as H_2S, HCl and HF. Other solar heating and cooling materials were found to be more thermally stable and hence should not outgas if the solar system fails.

38481 (SERI—22) **Proceedings of the desiccant cooling conference of November 16, 1977.** Shelpuk, B. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1978. Contract EG-77-C-01-4042. 98p. (CONF-7711108—(Summ.)). Dep. NTIS, PC A05/MF A01.

From Desiccant cooling conference; Golden, CO, USA (16 Nov 1977).

This report presents an overview of adsorption processes applied to solar cooling and a summary of the proceedings of a meeting on the current status of the technology. The meeting focused on a discussion of existing Department of Energy programs and on the extent to which they are able to deal with the important research issues identified by the participants. Descriptions of existing programs are included, and remaining key issues are summarized along with suggestions for their resolution. A data base of related literature is included as an appendix.

38482 (TAC-STHC—78-003) **Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July—September 1978.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jan 1979. 119p. Univ. of New Mexico, Albuquerque, NM.

This bibliography covers the following subjects: system overviews; computer models; demonstration; thermal storage; architectural considerations; passive solar energy; thermal load computations; domestic water heating; insolation and instruments, swimming pools, and greenhouses. It contains an author index and a keyword index. (MHR)

38483 **Solar heater freeze protection system.** Cartland, W.H. (to Rheem Manufacturing Co.). US Patent 4,138,996. 13 Feb 1979. Filed date 28 Jul 1977. 6p.

A solar water heating system heats water in a solar panel and stores it in a water storage tank. A pump circulates the water in the system, from the water storage tank through the solar panel back to the water storage tank when energy can be transferred from the solar panel to the water. When the circulating pump stops, the water in the solar panel and associated conduits located in an area where

freezing can be encountered drains down into the water storage tank and associated conduits which are located in an area where freezing will not be encountered. In order to provide for the necessary space in the system for draining, a predetermined air space is maintained in the top of the water storage tank by an automatic air replenishment system which includes a compressor for directing compressed air into said water storage tank at the top thereof at a predetermined maximum water level in accordance with a water level float operated control located adjacent the water storage tank. The water level float device comprises a float in a cylinder having a magnet connected to the top thereof, said magnet being moved by changes in water level to in turn actuate a second magnet at a predetermined water level which operates a switch for controlling the air compressor.

38484 **Farmstead heated with solar energy.** *Sonnenenergie-Tech.;* 2: No. 7, 8-9(Dec 1976). (In German and English).

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

38485 (COO—4274-1) **Solar energy system design for a lobster aquaculture facility.** (Sanders Associates, Inc., Nashua, NH (USA). Defensive Systems Div.). 30 Sep 1977. Contract EG-77-C-02-4274. 123p. Dep. NTIS, PC A06/MF A01.

In aquaculture, as in most manufacturing processes, the operating cost is greatly dependent upon the cost of energy. The objectives were to: (a) analyze the power requirements for a lobster aquaculture plant, and (b) to evaluate the use of solar energy as a cost reduction measure in plant operation. A flat plate collector system capable of supplying heat alone was compared with a total energy system in which both electrical power and heat were supplied. The flat plate collector was not cost effective because when heat was needed in December, the least amount of heat was available from solar radiation. Therefore, the collector area and cost were prohibitive. However, the total energy system was cost effective when the capital investment was amortized over ten or more years. The optimum solar power plant was designed to provide 100% of the average yearly power demands, or 60% of the December power requirement. This plant would consist of 60,000 square feet of mirror surface (3.5 acres of land for 40% packing density) which would concentrate 1500 to 2000 suns on a receiver mounted on an 85 foot tower. In the tower would be the three storage stoves which would contain the heat required to operate a 343 KWe Brayton gas turbine engine and alternator for 27 hours. Equipment to generate 3 million kw-hr annually will cost an estimated $1.3 million.

38486 (COO—4517-1) **Solar supplement to laundry drying. Annual progress report, October 31, 1977—October 31, 1978.** Smith, C.C. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4517. 22p. Dep. NTIS, PC A02/MF A01.

A project is reported which utilizes solar energy to supplement the heating energy requirements of a large commercial type laundry dryer. Air is solar heated in flat-plate collectors and is introduced into the air intake of a dryer. The air is drawn directly from the outdoor ambient air. This system is designed for direct supply of solar heated air to the dryer with no solar heat storage. Solar heat storage could not be justified economically due to the close match in schedule between solar availability and laundry operation. The factors associated with selection of a hospital laundry facility for the project site are discussed. The design of the system for solar laundry drying is presented.

38487 (NAL-BIBL—78-04) **Solar energy in agriculture, 1970—1977: 236 citations. Quick bibliography series.** Lewis, N.H. (Department of Agriculture, Beltsville, MD (USA)). Apr 1978. 38p. USDA, Beltsville, MD.

WATER HEATING

REFER ALSO TO CITATION(S) 38464, 38472, 38478, 38482, 38483

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 38407, 38414

38488 (DOE/NASA/CR—161166) **Long term weathering effects on the thermal performance of the Solaron (air) solar collector.** Wyle Labs., Huntsville, AL (USA). Solar Energy Systems Div.). Mar 1979. Contract EX-76-A-29-1037. 13p. Dep. NTIS, PC A02/MF A01.

The test procedures and the results obtained during the evaluation test program on the Solaron Corporation air-type solar collector are presented. The tests were performed under simulated conditions, following long-term exposure to natural weathering conditions. The Solaron Model 2001, air-type solar collector has a gross area of 19 square feet (35.25" x 77.63") and the weight is 160 pounds. The absorber plate is made of 24-gage steel, the coating is baked-on black paint, the cover consists of two sheets of 1/8-inch low-iron tempered glass, and the insulation is one thickness of 3 5/8-inch fiberglass batting.

38489 (DOE/NASA/TM—78219) **Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report.** Parker, J.C. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Mar 1979. Contract EX-76-A-29-1037. 27p. Dep. NTIS, PC A03/MF A01.

A summary is presented of the final results of Northrup, Inc., of Hutchins, Texas, for the additional development work on their existing ML Series concentrating solar collector Model NSC-01-0732 for use with solar heating and cooling systems. The intended use of the final report, the development hardware, deliverable end items, problems encountered during fabrication and testing, and certification statements of performance are included. It is shown that the products developed are marketable and suitable for public use.

38490 (DOE/NASA/TM—78223) **Development, testing, and certification of Owens—Illinois Model SEC-601 Solar Energy Collector System. Final report.** Parker, J.C. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1979. Contract EX-76-A-29-1037. 23p. Dep. NTIS, PC A02/MF A01.

The final results of Owens-Illinois, Toledo, Ohio, for the additional development work on their existing air-cooled solar energy collector subsystem for use with solar heating and cooling systems are summarized. The intended use of the final report is discussed, the deliverable end items are described, program objectives and how they were accomplished are listed, problems encountered during fabrication and testing are mentioned, and a certification statement of performance are included. It is shown that the products developed are marketable and suitable for public use.

38491 (DOE/NASA/TM—78225) **Solar tracking control system Sun Chaser.** Scott, D.R.; White, P.R. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1979. Contract EX-76-A-29-1037. 17p. Dep. NTIS, PC A02/MF A01.

The solar tracking control system (Sun Chaser) is believed to be an improved method of tracking the Sun in all types of weather conditions. The Sun Chaser will follow the Sun from east to west in clear or cloudy weather, and reset itself to the east position after sundown in readiness for the next sunrise. A description of the Sun Chaser hardware and its operation together with results is presented.

38492 (MLM—2606(OP)) **Evaluation of a large nonconvective solar pond.** Wittenberg, L.J.; Harris, M.J. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 12p. (CONF-790328—2). Dep. NTIS, PC A02/MF A01.

From Solar energy storage options workshop; San Antonio, TX, USA (18 Mar 1979).

This project is directed toward the evaluation of the operational performance of one of the largest functional, salt-gradient solar ponds in the world. This solar pond was constructed by the City of Miamisburg on property adjacent to the Mound Facility. In this study, data are collected on the annual thermal cycle characteristics of this combined solar energy collector and thermal storage system, and system performance is evaluated based upon models developed at several university research ponds.

38493 (N—78-28614) **Comparison of three experimental methods used in determining the thermal performance of flat-plate solar collectors. Ph.d. thesis - Kansas Univ.** Hotchkiss, G.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1978. 289p. NTIS PC A13/MF A01.

Three experimental methods for evaluating the thermal performance of flat-plate solar collectors are presented. The methods are classified according to the nature of the ambient conditions encountered during experimental testing. The classifications are: (1) steady state, (2) quasi-steady state, and (3) unsteady state. Experimental tests on two solar collectors were conducted in an indoor solar simulator and also out-of-doors. From the experimental collector data, collector efficiency factors, which describe the steady state behavior of a collector, were determined for each experimental method. A parameter identification method based upon a discrete gradient optimization technique was used to determine the collector parameters from unsteady state data. Such a method would allow on-line data reduction and would enable speedy determination of the collector efficiency factors from transient data. The design, construction, and operation of the test rig which was used to obtain the experimental data are also described.

38494 (PB—283721) **Provisional flat plate solar collector testing procedures: first revision. Interim report.** Waksman, D.; Streed, E.R.;

Reichard, T.; Cattaneo, L.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jun 1978. Contract DOE-EA-77-A-01-6010. 66p. NTIS PC A04/MF A01.

The test methods contained in this report and the provisional rating criteria presented in an appendix are intended for use in determining the thermal performance, and to aid in the assessment of the safety and durability/reliability of flat plate solar collectors.

38495 (PB—283783) **Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974—31 January 1976.** Hollands, K.G.T.; Raithby, G.D.; Unny, T.E. (Waterloo Univ., Ontario (Canada)). Jun 1976. Contract ERDA-E(11-1)-2597. 138p. NTIS PC A07/MF A01.

Improvements to flat plate solar collectors for heating and cooling of buildings are evaluated through three parallel studies. The first study demonstrates suppression of free convection by a honeycomb at all angles of inclination. Reductions by a factor of 5 in the free convective heat loss are reported, and equations and charts permitting the rational design of honeycombs for convection suppression in solar collectors are presented. The second study resulted in a precise, easily programmable set of equations for the free convective heat loss through the air gaps in flat plate solar collectors, for any angle of tilt. The third study theoretically and experimentally demonstrated that the solar transmittance of a flat transparent cover for a solar collector can be very substantially increased by V-corrugating.

38496 (SAND—76-0347) **Helios model for the optical behavior of reflecting solar concentrators.** Biggs, F.; Vittitoe, C.N. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 324p. Dep. NTIS, PC A14/MF A01.

The Helios model simulates the optical behavior of reflecting concentrators. The model follows the incident solar radiation through the system (including the atmosphere) and includes all the factors that influence the optical performance of a collector. An important output is the flux-density pattern (W/cm^2) at a grid of points on a surface such as the absorbing surface of a receiver and its integral (power in watts) over the surface. The angular distribution of sunrays for the radiation incident on a concentrator is modified by convolution, using the fast Fourier transform, to incorporate the effects of other nondeterministic factors such as sun-tracking errors, surface slope errors, and reflectance properties. The analytical methods used for the statistics, the off-axis reflecting optics, the atmospheric effects, and the various coordinate systems are described and illustrated. This model forms a basis for the simulation code HELIOS as well as for other codes under development. Some of the HELIOS routines are described, a few of its capabilities are discussed and illustrated, and comparisons of data with calculations are presented. These capabilities have been used for performance predictions, safety studies, design trade-offs, data analysis problems, the specification and analysis of concentrator quality, and for the general understanding of solar-concentrator technology.

38497 (SAND—78-0977) **Summary report. Concentrating solar collector test results Collector Module Test Facility (CMTF), January—December 1978.** Dudley, V.E.; Workhoven, R.M. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 54p. Dep. NTIS, PC A04/MF A01.

The results are summarized of tests on four concentrating solar collectors at output fluid temperatures from 100°C to 300°C. Collectors tested were manufactured by Scientific-Atlanta, Inc., General Electric, Del Manufacturing and Suntec, Inc.

38498 (SAND—78-0982) **Design considerations for a proposed passive vacuum solar annular receiver.** Harrison, T.D.; Bond, G.N.; Ratzel, A.C. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

One of the collector field subsystems being evaluated at the DOE/Sandia Midtemperature Solar Systems Test Facility (MSSTF) is an East-West (E-W) 90°parabolic trough. This subsystem incorporates a receiver, the absorber tube of which is concentric with a larger glass tube. It was the orginal intention that there be a capability for measuring collector performance with and without vacuum in the annulus between the two tubes. Forty-three months (June 1975—December 1978) of testing have revealed problems associated with achieving and maintaining annulus pressures below 1 Pa along with other receiver problems and maintaining annulus pressures below 1 Pa along with other receiver problems (black-chrome degradation) that have reduced the performance of the collector. Analyses included in this report show that a vacuum in the annulus of the receiver assembly can significantly increase the amount of energy collected daily by at least 13% depending upon the reflector trough and tracking capabilities of the collector design. The problems associated with the current receiver are described and a modified passive-vacuum design intended to correct the problems is presented. Test results will determine whether the value of the additional energy collected is greater than the cost of achieving the vacuum.

38499 (SAND—78-1769) **Heat loss reduction techniques for annular solar receiver designs.** Ratzel, A.C.; Simpson, C.E. (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract EY-76-C-04-0789. 56p. Dep. NTIS, PC A04/MF A01.

Analytical and experimental work has been undertaken to quantify thermal conduction and natural convection heat losses in annular solar receiver geometries. Techniques studied for reducing conduction heat loss include evacuation of the annulus gas, oversizing of the annular space while maintaining slight vacuum levels, and use of gases other than air in the annular space. The receiver configuration chosen for study is typical of those used in the Mid-temperature Solar Systems Test Facility at Sandia Laboratories. The receiver tube has a black-chrome selective coating and is 2.54 cm in outside diameter. The inside diameter of the glass envelope is approximately 4.4 cm. Typical maximum operating temperatures of the receiver tube and glass envelope are approximately 589 K and 373 K, respectively.

38500 (SAND—78-7034) **Solar collector subsystem preliminary design program. Final report.** (Raytheon Co., Bedford, MA (USA). Missile Systems Div.; Sandia Labs., Albuquerque, NM (USA); Sandia Labs., Livermore, CA (USA)). 6 May 1977. Contract EY-76-C-04-0789. 335p. (BR—9795). Dep. NTIS, PC A15/MF A01.

This report describes preliminary design studies of a point—concentrator and collector field for Solar Total Energy Systems (STES) application. Requirements for the collector field subsystem used in the study are derived from STES requirements determined by Sandia systems engineering. The objectives of the study were: (1) Determine the optimum configuration of a commercial collector field capable of producing 10,000 kW (thermal) energy at noon on a defined equinox day. (2) Perform an economic analysis of the field yielding a defined figure-of-merit relatable to cost of energy delivered. (3) Perform a preliminary design study of a demonstration collector field, capable of delivering up to 2.44×10^6 kJ on a defined solstice day. (4) Perform engineering tests as required to support the demonstration field preliminary design activity.

38501 (SAND—79-0515) **Performance testing of the del concentrating solar collector.** Dudley, V.E.; Workhoven, R.M. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 28p. Dep. NTIS, PC A03/MF A01.

The results of tests performed on the Del Solar Collector at the Midtemperature Solar Systems Test Facility are summarized. Test objectives are defined, test procedures are described, and test results and conclusions are given.

38502 **Relationship of optical degradation to surface morphology changes in solar absorbers.** Zajac, G.; Ignatiev, A. (University of Houston, Houston, Texas 77004). *J. Vac. Sci. Technol.;* **16**: No. 2, 233-235(Mar 1979).

The physical basis for high-temperature optical degradation of electrodeposited black chrome coatings has been investigated via scanning electron microscopy and Auger electron spectroscopy coupled with inert gas depth profiling. Severe oxidation of the metallic chromium in the coatings has been observed and it is believed to result in shape changes of the particles comprising the film thereby decreasing their near-ir absorptance as is observed for air heat-treated coatings.

38503 **Radiation energy converter.** Cuomo, J.J.; Woodall, J.M.; Ziegler, J.F. (to International Business Machines Corp., Armonk, NY (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,539,101/C/. 20 Oct 1977. 6p. (In German).

A solar light-heat converter which can be operated at high conversion efficiency can be made relatively simply if, according to the invention, one lets a dendritic arrangement of absorption material grow on a substrate as wide band absorber for photons. The dendritic arrangement includes fibrous whiskers arrranged more or less parallel to each other, made of a material of small radiation emission capacity. Tungsten is used for preference. The density of packing, length and thickness of the whiskers are in the order of magnitude of several wavelengths of the radiation to be converted. Tungsten, sapphire or stainless steel are used as substrates.

HEAT STORAGE

REFER ALSO TO CITATION(S) 38457, 38461, 38482, 38492, 38837, 38838

38504 (COO—4523-1) **Stratified thermal storage in residential solar energy applications.** Sharp, M.K.; Loehrke, R.I. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Jun 1978. Contract EG-77-S-02-4523. 64p. Dep. NTIS, PC A04/MF A01.

The benefits of thermal stratification in sensible heat storage were investigated for several residential solar applications. The

operation of space heating, air conditioning and water heating systems with water storage was simulated on a computer. The performance of comparable systems with mixed and stratified storage was determined in terms of the fraction of the total load supplied by solar energy. The effects of design parameters such as collector efficiency, storage volume, tank geometry, etc., on the relative advantage of stratified over well-mixed storage were assessed. The results show that significant improvements in system performance (5 to 15%) may be realized if stratification can be maintained in the storage tank. The magnitude of the improvement is greatest and the sensitivity to design variables is smallest in the service hot water application. The results also show that the set of design parameters which describes the optimum system is likely to be substantially different for a system employing stratified storage than for a mixed storage system. In both the water heating and space heating applications collector flowrates lower than currently suggested for mixed storage systems were found to yield optimum performance for a system with stratified storage.

38505 (COO—4702-3) **Engineering design for thermocrete central storage units for low temperature solar application. Monthly technical report, August—September 1978.** Chahroudi, D. (Suntek Research Associates, Corte Madera, CA (USA)). 1978. Contract EW-78-C-02-4702. 3p. Dep. NTIS, PC A02/MF A01.

Appropriate computer modeling techniques have been identified. Preliminary testing of phase change materials sub-units is being performed. (MHR)

38506 (MLM—2598(OP)) **Energy storage for solar air conditioning applications utilizing a form-stable, high density polyethylene pellet bed.** Whitaker, R.B.; Jenkins, G.H.; Ball, G.L.; Salyer, I.O. (Monsanto Research Corp., Dayton, OH (USA)). 1979. Contract EY-76-C-04-0053. 10p. (CONF-790328—1). Dep. NTIS, PC A02/MF A01.

From Solar energy storage options workshop; San Antonio, TX, USA (18 Mar 1979).

The results obtained from a cost-effectiveness comparison of three different methods of crosslinking high-density polyethylene (HDPE) to make it a form-stable, useful thermal energy storage (TES) material are presented in some detail. In addition, the projected costs of a proposed HDPE-liquid thermal transfer system are compared to those of other liquid and air thermal transfer TES systems operative in the same 100 to 150°C range. (MHR)

38507 (SAND—79-0246C) **Corrosion in molten salts used for solar thermal storage applications.** Smyrl, W.H. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 12p. (CONF-781228—1). Dep. NTIS, PC A02/MF A01.

From Reliability of materials workshop; Denver, CO, USA (18 Dec 1978).

Some of the broad outlines of corrosion behavior are discussed. The compatibility of materials with the molten nitrate—nitrite class of salts selected for solar thermal storage applications is discussed at some length. A brief summary is given of recommendations for areas of future work on these salts to increase the reliability of materials behavior in solar systems. (MHR)

38508 Solar energy storage and utilization. Yuan, S.W. US Patent 4,138,995. 13 Feb 1979. Filed date 25 Aug 1976. 8p.

A system for storing and utilizing solar energy is disclosed which includes the use of solar energy collectors attached to heat pipes for changing solar flux into heat energy and transmitting the heat energy into the earth below the surface of the ground. An expanding array of pipes, formed of heat conductive material, distributes the heat throughout a large, unconstrained volume of underground earth. The system provides for long-duration earth storage of the heat energy which can later be used for both space and hot water heating in homes, multiple-unit housing, commercial buildings, public buildings, etc. A uni-directional heat pipe, characterized by having irreversible vapor flow, includes a pump arrangement for transferring working fluid from the condenser section to the evaporator section of the heat pipe.

GEOTHERMAL ENERGY

38509 Reference data: a basic plan for research and development. *Genshiryoku Kogyo;* **24**: No. 11, 88-95(1978). (In Japanese).

An energy resource and development plan is presented in tabular form. It is divided into research subject, research projects, major research topic, and investigators involved. Geothermal energy technology included the following: hot-water power generation methods, volcanic power generation, exploration and exploitation techniques, multi-purpose utilization, and environmental conservation techniques. Under the general topic of atomic energy, it covers the refining and conversion of uranium, uranimum concentration by centrifugal separation, recycling of used nuclear fuel, treatment of radioactive wastes, processing and handling of plutonium, a study on the safety of light water pipe, a new type converter, a high-speed breeding reactor, nuclear fission, and an atomic ship. Also covered are gasification of coal, liquifaction of coal, a multi-purpose, high temperature gas furnace, the manufacture of olefin from heavy oil, and a submarine petroleum production system. Also covered are solar energy and photopower generation, wave power generation, solar heating and cooling, and a solar hot water system. Also covered are magnetic fluid (MHD) power generation, hydrogen energy technologies, high temperature reductive gas direct iron making, resources recycling technology, energy saving housing system, waste heat utilization systems, and natural energy utilization in agriculture.

38510 Federal R and D funding: modest gains in 1979. Long, J. R. (Chemical and Engineering News, Washington, D.C.). *Chem. Eng. News (Wash., D.C.);* **56**: No. 43, 16-17(1978).

Federal research and development funding for 1979 is reviewed, and for most sectors was at least 1% above 1978 funding. Defense funding increased by 7% and NASA'S research funding was increased by 9.3%. Some funding for energy research and development was cut this year: fossil energy down 9.2%, space nuclear systems down 19%, and energy production, demonstration and distribution programs, down 10%. Geothermal energy programs requested $124.3 million and received $132.6 million (the 1978 level was $103.7 million). Programs that showed an increase include: breeder reator up 26%, light water reactors up to 9.5%, biomass up 13%, and solar up 5%. The National Institute of Health's funding was increased by 7.6%, and the National Science Foundation received a 5% increase. The Environmental Protection Agency's funding is 3% over 1978 levels. One table provided

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 38532

38511 New energy technology- Strategy and evaluation. Yorozu, M. (Mitsubishi Institute of Technology and Economics, Japan); Tsuda, S. *Genshiryoku Kogyo;* **24**: No. 11, 47-52(1978). (In Japanese).

Of the new energy resources including solar, geothermal, wind, and tidal, Japan has more than 200 geothermal energy resources which produce 1% of the geothermal energy in the world. At present, exploration and explotation technologies, a hot-water utilizing technique, environmental conservation methods, multi-purpose utilization techniques, and a large scale geothermal experimental facility are being developed at national research institutes, universities, and in private industry. Geothermal steam power generation is performed at five power plants, but hot water power generation techniques such as hot water speciality or steam-combined type 1000 kW binary cycle power generation has been done since 1978 on a pilot basis. On the basis of these results, a 20,000 to 50,000 kW binary cycle power generation system is scheduled for development. An artificial hydrothermal power generation system is also described as a possibility for 1990. Nine figures and three tables are provided.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

38512 (LBL—8802) **Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies.** Pruess, K.; Zerzan, J.M.; Schroeder, R.C.; Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 17p. (CONF-790119—2). Dep. NTIS, PC A02/MF A01.

From 5. symposium on reservoir simulation; Denver, CO, USA (31 Jan 1979).

The algorithm of SHAFT78 is based on mass and energy-balance equations for two-phase flow in a porous medium. The basic differential equations are converted into integrated finite-difference form. This allows regular and irregular reservoir shapes to be handled with the same ease. The equations are solved semi-implicitly for discrete time steps. The present version of SHAFT78 treats the coupling between mass and energy flow in a noniterative way. Special provisions are made to compute phase transitions with high accuracy. The program was verified by computing a number of sample problems that previously had been investigated by other authors. Model studies reveal that two-phase geothermal reservoirs are capable of a great variety of pressure responses upon production. It is shown that the standard technique of estimating reserves by extrapolating a plot of p/Z vs cumulative production is not applicable to two-phase geothermal reservoirs. A bulk model (lumped parameters) was developed for a two-phase reservoir that admits an

analytical solution for pressure decline upon production. From this it is concluded that in many cases pressure will be a linear function of cumulative production, with the slope allowing an estimate of total reservoir volume. Reserve assessment requires knowledge of average porosity and vapor saturation, which cannot be obtained from pressure decline curves.

USA

38513 (PB—284221) **Geohydrologic data from the Jemez Mountains and vicinity, north-central New Mexico. Final report.** Trainer, F.W. (Geological Survey, Albuquerque, NM (USA). Water Resources Div.). Jan 1978. 54p. NTIS PC A04/MF A01.

The Jemez Mountains volcanic region, on the west margin of the Rio Grande rift in north-central New Mexico, is the site of studies whose objective is power development from geothermal heat. This report summarizes geohydrologic data obtained to provide background information relative to the geothermal exploration and to investigate the usefulness of hydrology in assessment of the geothermal resource. Eleven tables present chemical, temperature, discharge, and other data for springs, wells, and streams. Accompanying figures show locations of the data points and present temperature profiles and geophysical logs for selected wells.

38514 **Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790.** Boulder, CO; National Geophysical and Solar-Terrestrial Data Center (1979). vp.

This map shows identified hydrothermal convection systems, igneous systems, low temperature geothermal waters, regional heat flow, and KGRA's. (MHR)

38515 **Geothermal energy in Alaska and Hawaii. Map 2 of U.S. Geological Survey Circular 790.** Boulder, CO; National Geophysical and Solar-Terrestrial Data Center (1979). vp.

This map shows identified hydrothermal convection systems, igneous systems, low-temperature geothermal waters, heat flow data, and KGRA's. (MHR)

38516 **Geopressured-geothermal energy in reservoir fluids of the northern Gulf of Mexico Basin. Map 3 of U.S. Geological Survey Circular 790.** Boulder, CO; National Geophysical and Solar-Terrestrial Data Center (1979). vp.

This map shows depth to top of geopressured zone, thermal energy in sand beds, methane energy in sand beds, high potential areas for geopressurized development, temperature at 15,000 ft in selected wells, major subsurface faults, and major offshore area boundaries. (MHR)

38517 **Development of geothermal energy in Japan.** Vuataz, F.D. *Bull. Tech. Suisse Romande;* **104**: No. 23, 335-340(Nov 1978). (In French).

Natural surface manifestations of geothermal energy have been utilized in Japan throughout history. Thermal areas are numerous and frequently related to active volcanic areas and Quaternary volcanism. There are hot water systems and vapor dominated systems. Prospecting for geothermal fluids utilizes several simultaneous methods. Geological surveys can locate favorable geothermal areas. These areas are often associated with faults, graben, calderas, and hydrothermal alteration. Geochemical methods are used to determine underground temperatures and the size and capacity of reservoirs. Geophysical techniques determine the depth of underground active zones, depth of reservoirs, and rock permeability. Infrared methods and well digging are also used. Five Japanese power plants produce 90 MW of power. This modest yield will be expanded to produce 350 MW by 1980 and 50,000 MW between now and the year 2000. One table and four figures are provided.

NON-USA

REFER ALSO TO CITATION(S) 38539

38518 (LBL—7076) **Simulation of the Krafla Geothermal Field.** Jonsson, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

Simulation studies have recently been made of the Krafla Geothermal Field in Northern Iceland. The field is close to boiling in the formation at depths of 1800 meters and below. Two simulations were undertaken. The first studied radial flow, i.e., behavior around a production well. It was found that the relative permeability distribution of the liquid and vapor phase had very little effect on the general results. The simulation shows that while the well produced superheated steam after a few days of production, the superheated front moved only 1/10 the distance of the boiling front, which extended to a radial distance of over 200 meters after one-half year production. The second simulation investigated the two-zone system which is believed to exist in Krafla. This study simulated one well producing 50 kg/s from both zones for a period of 33 years. It showed that boiling in the formation begins near the production well and at the connection between the two zones. After 20 years, boiling takes place in the entire lower zone region with saturation (steam volume fraction) ranging from 0-30 percent. After 33 years, saturation increased to over 60 percent at the top of the lower zone, just under the caprock separating the two zones. Higher production rates will augment the spread of the saturation proportionately to the ratio of mass production.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 38517

38519 (LA-UR—79-665) **Geothermal exploration methods and results: inland states.** Maxwell, J.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-790433—2). Dep. NTIS, PC A02/MF A01.

From Symposium on geothermal energy and its direct uses in the eastern United States; Hot Springs, VA, USA (5 Apr 1979).

The Los Alamos Scientific Laboratory (LASL) geothermal exploration sequence includes: (a) review of AAPG/USGS gradient maps, (b) literature search, (c) consideration of potential markets, (d) groundwater silica geothermometry, (e) analysis of bottom-hole temperatures, (f) heat flow measurement of available wells, and (g) drilling of new test holes. This procedure has located anomalies near Syracuse, NY (36°C/km, 56°C silica max.), near Buffalo, NY (36°C/km, 65°C silica max.), southeast Ohio, western and southwestern Nebraska, and three new warm springs in Arkansas. Other investigations have found high heat generation (14 to 25 HGU) in the White Mountain batholith NH (170°C calculated at 6 km depth), uparching of the Adirondac Dome, NY, and potentially economic electricity from hot brines in southwest Arkansas.

GEOPHYSICAL TECHNIQUES AND SURVEYS

38520 (COO—2534-4) **Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1977—August 31, 1978.** Aki, K. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1978. Contract EY-76-S-02-2534. 29p. Dep. NTIS, PC A03/MF A01.

New seismological methods were developed for determining the structure of a geothermal energy source region by the use of data from both active and passive experiments. Technical papers were published on four topics, namely: a field experiment at Kilauea Iki, source models of volcanic tremors, microearthquake source spectra, and a numerical study of elastic wave diffraction by fluid-filled cracks. In addition, papers were submitted for publication on a statistical synthesis of source mechanism of seismic events in Kilauea Iki and the observation of a temporal variation in the attenuation of earthquake coda in central California. The following subjects were worked on: (1) interpretation of seismic data from the LASL Hot Dry Rock system; (2) analyisis of volcanic tremor data from the U.S.G.S. Hawaiian seismic network; (3) frequency dependence and three-dimensional distribution of seismic attenuation in central Japan; (4) experimental study of seismic scattering by a penny-shaped crack; (5) development of a microprocessor system for the treatment of the data from digital event recorders.

38521 **The map of heat flow in Europe and its role in the preliminary evaluation of the sources of geothermal energy.** Cermak, V. (Geophysics Institute, Czechoslovakia Academy of Sciences, CSSR). pp 52-57 of Nordic symposium on geothermal energy. Goteborg, Sweden; Chalmer University of Technology and University of Goteborg, Sweden (1978).

From Nordic Symposium on Geothermal Energy;

The heat flow map of Europe was derived from 2605 existing observations, which were supplemented by numerous results of deep temperature and gradient observations. In areas without data the heat flow field was extrapolated on the basis of the tectonic structure and the correlation of heat flow and the age of the last tetonothermal event. Increased value of the terrestrial heat flow reflects high subsurface temperature at accessible depths. The knowledge of the distribution of the zones of anomalous heat flow can thus serve in the preliminary estimates of perspective geothermal resources. With the use of the heat flow map the most promising regions for future applied geothermal prospecting can be projected. One figure and six references are provided.

38522 **Geothermal survey with infrared radiation thermometer and thermister thermometer- Namekawa Spa and Ubayu Spa.** Shida, I. (Yamagata University, Japan); Minakawa, S.; Abe, M. *Yamagata Daigaku Kiyo, Shizenkagaku;* **9**: No. 2, 153-168(Feb 1977). (In Japanese).

The soil surface temperature and 1 m depth soil temperature were measured at Manekawa Spa with an infrared radiation thermometer and at Ubayu Spa with a thermistor thermometer. These measurements were part of an investigation of thermal waters in the area. The infrared radiation thermometer was most useful when the measurements were made on bare ground in fair weather. The results of the survey indicated that there are probably more geothermal resources than presently obvious in Namekawa but not at Ubayu. Eleven figures, four tables and four references are provided.

GEOCHEMICAL TECHNIQUES AND SURVEYS

38523 Pre-calculation of the temperature of air currents in a tunnel designed to excavate in the rock mass at high temperature. Mizuta, Y.; Miyasaka, T. *Yamaguchi Daigaku Kogakubu Kenkyu Hokoku;* **28**: No. 2, 151-159(Mar 1978). (In Japanese).

There is a demand for temperature prediction simulations applicable to under ground environments. It is difficult to analyze the heat transfer across airways while taking rock conduction and spring flow rate into consideration. First, the energy balance analysis method was investigated based on meteorological observation of a drift under development in the Toyoha mine. Using these results, calculations were made of the flow rate, temperature, and humidity of air currents in a tunnel model. Five figures, 11 tables, and 12 references are provided.

EXPLORATORY DRILLING AND WELL LOGGING

38524 (LA—7693-MS) **Geothermal well log interpretation mid-term report.** Sanyal, S.K.; Wells, L.E.; Bickham, R.E. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-31-109-ENG-38. 253p. Dep. NTIS, PC A12/MF A01.

Reservoir types are defined according to fluid phase and temperature, lithology, geologic province, pore geometry, and salinity and fluid chemistry. Improvements are needed in lithology and porosity definition, fracture detection, and thermal evaluation for more accurate interpretation. Further efforts are directed toward improving diagnostic techniques for relating rock characteristics and log response, developing petrophysical models for geothermal systems, and developing thermal evaluation techniques. The Geothermal Well Log Interpretation study and report has concentrated only on hydrothermal geothermal reservoirs. Other geothermal reservoirs (hot dry rock, geopressured, etc.) are not considered.

38525 (LA-UR—79-723) **Development of integrated thermionic circuits for geothermal high-temperature applications.** McCormick, J.B.; Wilde, D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-790605—1). Dep. NTIS, PC A02/MF A01.

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A new integrated thermionic device capable of withstanding ambient temperatures in excess of 500°C is reported. The evolution of the integrated thermionic circuit (ITC) is discussed and a set of practical device design and performance equations are demonstrated.

38526 (LBL—8675) **Evaluation of Coso Geothermal Exploratory Hole No. 1 (CGEH-1) Coso Hot Springs: KGRA, China Lake, CA.** Goranson, C.; Schroeder, R.; Haney, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 17p. (CONF-781222—2). Dep. NTIS, PC A02/MF A01.

From 4. workshop on geothermal reservoir engineering; Stanford, CA, USA (13 Dec 1978).

The well, Coso Geothermal Exploratory Hole No. 1 (CGEH-1) was drilled at the China Lake Naval Weapons Center. Drilling was started on 2 September 1977, and the well completed on 1 December 1977 to 4845 ft. The well is an exploratory hole to determine geological and hydrothermal characteristics of the Coso Hot Springs KGRA (Known Geothermal Resource Area). During drilling, numerous geophysical and temperature surveys were performed to evaluate the geological characteristics of CGEH-1. LBL performed eight temperature surveys after completion of the well to estimate equilibrium reservoir temperatures. Downhole fluid samples were obtained by the U.S. Geological Survey (USGS) and Lawrence Berkeley Laboratory (LBL), and a static pressure profile was obtained. Two flow tests were attempted in 1978. The first test began September 5, 1978 using nitrogen stimulation to initiate flow; this procedure resulted in small flow and subsequent filling of the bottom hole with drill cuttings. The second test, on November 2, 1978, utilized a nitrogen-foam-water mixture to clean residual particles from bottom hole, following which nitrogen was again used to stimulate the well. The well remained dry after stimulation. Water influx was calculated at 4-5 gal/min as the well filled after unloading of the wellbore.

38527 (SAND—79-0013C) **Technology development for high temperature logging tools.** Veneruso, A.F.; Coquat, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-790605—2). Dep. NTIS, PC A02/MF A01.

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A set of prototype, high temperature logging tools (temperature, pressure and flow) were tested successfully to temperatures up to 275°C in a Union geothermal well during November 1978 as part of the Geothermal Logging Instrumentation Development Program. This program is being conducted by Sandia Laboratories for the Department of Energy's Division of Geothermal Energy. The progress and plans of this industry based program to develop and apply the high temperature instrumentation technology needed to make reliable geothermal borehole measurements are described. Specifically, this program is upgrading existing sondes for improved high temperature performance, as well as applying new materials (elastomers, polymers, metals and ceramics) and developing component technology such as high temperature cables, cableheads and electronics to make borehole measurements such as formation temperature, flow rate, high resolution pressure and fracture mapping. In order to satisfy critical existing needs, the near term goal is for operation up to 275°C and 7000 psi by the end of FY80. The long term goal is for operation up to 350°C and 20,000 psi by the end of FY84.

ECONOMIC AND FINANCIAL ASPECTS

38528 (HCP/T1021—36) **Market survey of geothermal wellhead power generation systems. Final report, March 1978.** Leeds, M.W.; Evensizer, J. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1979. Contract EG-77-A-36-1021. 52p. Dep. NTIS, PC A04/MF A01.

The purpose of this study was to assess the market potential for a portable geothermal wellhead power conversion device (1-10 MW generating capacity). Major study objectives included identifying the most promising applications for such a system, the potential impediments confronting their industrialization, and the various government actions needed to overcome these impediments. The heart of the study was a series of structured interviews with key decision-making individuals in the various disciplines of the geothermal community. In addition, some technical and economic analyses of a candidate system were performed to support the feasibility of the basic concept.

38529 A consideration of geothermal energy. Araki, T. *Kogyo Gijutsu;* **19**: No. 9, 70-71(1978). (In Japanese).

Successful research and development of geothermal energy depends on the level of scientific knowledge, the technological level, and on the availability of financial support. The Los Alamos Scientific Laboratory in the U.S. is described. A hot-dry-rock power generation project is underway. The research and development are supported by the high U.S. scientific and technological levels and a large research and development fund. In Japan technological developments such as excavation techniques and water pressure fracture, and the development of various exploratory and survey technologies and devices, have been made by private firms and research institutions. A research and development fund under the Japanese Sunshine Project has invested on only one project, 13.7 hundred million yen in 1975 and 16.1 hundred million yen in 1976.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 38089, 38599

38530 (TREE—1340) **1978 annual report, INEL geothermal environmental program.** Spencer, S.G.; Sullivan, J.F.; Stanley, N.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 65p. Dep. NTIS, PC A04/MF A01.

The objective of the Raft River Geothermal Environmental Program, in its fifth year, is to characterize the beneficial and detrimental impacts resulting from the development of moderate-temperature geothermal resources in the valley. This report summarizes the monitoring and research efforts conducted as part of this program in 1978. The results of these monitoring programs will be used to determine the mitigation efforts required to reduce long-term impacts resulting from geothermal development.

GEOTHERMAL POWER PLANTS

38531 (COO—4051-25) **Available work in geothermal energy.** Kestin, J. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jul 1978. Contract EY-76-S-02-4051. 95p. Dep. NTIS, PC A05/MF A01.

The most important thermodynamic considerations needed for a clear understanding of the operation of geothermal installations used for the production of electricity are presented. A brief description is given of the nature of a geothermal reservoir and the characteristics of the most practical systems for the conversion of geothermal energy into work are described. The appropriate specialized forms of the First and Second Laws of Thermodynamics are derived and the related concepts of optimum available work, available work, entropy production, dissipated energy, and utilization factor are introduced. The shortcomings of the method of cycle analysis are discussed when applied to geothermal plants. Special attention is devoted to a detailed discussion of the most important general indicators that follow for the designer from a thermodynamic analysis. Various methods of graphically interpreting the concept of available work are described in detail and the importance of easily accessible, reliable formulations of the thermophysical properties of the pure substances, solutions, and mixtures that the designer needs for success are discussed. (MHR)

38532 (COO—4051-27) **Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21.** DiPippo, R. (Brown Univ., Providence, RI (USA). Dept. of Engineering). Jul 1978. Contract EY-76-S-02-4051. 129p. Dep. NTIS, PC A07/MF A01.

Worldwide geothermal power plant installed capacity is listed by country with year of startup. Tables containing technical data are given for each of the geothermal power units installed in the world and for some of those under construction or in planning. The data cover the primary mechanical areas of the power station including the turbine, condenser, gas extraction system, and heat extraction system. In the case of plants which are in the planning stage or under construction, the plant design specifications are listed but must be viewed as preliminary. (MHR)

38533 (COO—4051-40) **Kakkonda Geothermal Power Plant.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth (USA); Brown Univ., Providence, RI (USA)). Jan 1979. Contract EY-76-S-02-4051. 14p. Dep. NTIS, PC A02/MF A01.

Based on a translation of a brochure from the Japan Metals and Chemicals Co., Ltd.

A brief general description is given of a geothermal resource. Geothermal exploration in the Takinoue area is reviewed. Geothermal drilling procedures are described. The history of the development at the Takinoue area (the Kakkonda Geothermal Power Plant), and the geothermal fluid characteristics are discussed. The technical specifications of the Kakkonda facility are shown. Photographs and drawings of the facility are included. (MHR)

38534 (COO—4051-41) **Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth (USA); Brown Univ., Providence, RI (USA)). Jan 1979. Contract EY-76-S-02-4051. 25p. Dep. NTIS, PC A02/MF A01.

Some of the geothermal areas in the Soviet Union which may support electric generating stations are described. The plants at Pauzhetka (single-flash steam), at Paratunka (Freon binary), and at Bolshoye-Bannoye (multi-flash steam) are described in technical detail. The reference list contains some of the most recent sources of information on geothermal power plant developments in the Soviet Union.

38535 (N—78-27533) **A market survey of geothermal wellhead power generation systems. Final report.** Leeds, M.W. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1978. Contracts NAS7-100;EG-77-A-36-1021. 53p. NTIS PC A04/MF A01.

The market potential for a portable geothermal wellhead power conversion device is assessed. Major study objectives included identifying the most promising applications for such a system, the potential impediments confronting their industrialization, and the various government actions needed to overcome these impediments. The heart of the study was a series of structured interviews with key decision-making individual in the various disciplines of the geothermal community. In addition, some technical and economic analyses of a candidate system were performed to support the feasibility of the basic concept.

38536 **Status of geothermal energy development in 1976.** Baba, K. (Oversea Liaison Committee, Japan); Hase, H.; Aozaki, T.; Adachi, S.; Kakegawa, S.; Sato, K.; Sano, S.; Chiba, G.; Hasegawa, J.; Hayakawa, M.; Hitosugi, T.; Watanabe, K. *J. Jpn. Geotherm. Energy Assoc.;* **14**: No. 2, 35-58(1977). (In Japanese).

The 1976 status of Japan's four geothermal power plants is reviewed. The Otake power plant operated at 95% capacity, and the Matsukawa power plant operated at 78% capacity. Power output at Onuma geothermal plant is expected to reach 7500 kW and production is expected to reach 12,000 kW at Onikobe as new production wells are completed. A 50,000 kW plant is scheduled for completion at Hatchobara in June 1977 and at Kakkonda in August 1978. Detailed investigations for geothermal exploitation by the government were carried out in 1976 in Shikotan and Doya in Hokkaido, Shimokita, Southern Hachimantai, KitaAlpse, and others. Basic investigations were also conducted in seven geothermal areas including Sobetsu, Kowase, Hanamaki, and Garandake. In American in The Geysers Geothermal Field, No. II plant with a capacity of 110 MW began operation in 1976, and plants Nos. 12, 13, 14, and 15 are being planned. In the Imperial Valley area, a pilot plant with a binary system is being tested. In the Philippines, geothermal power plants in the Tiwi and Los Banos islands are being constructed. Mexico and El Salvador also have an interest in developing geothermal energy. Two tables and one map are provided.

38537 **How to develop geothermal energy in Japan.** Sato, K. (Geothermal Subcommittee of the Industrial Technology Council, Japan). *J. Jpn. Geotherm. Energy Assoc.;* **14**: No. 3, 29-33(1977). (In Japanese).

The development of geothermal energy depends upon the determination of geothermal resources, geothermal power generation technology, and environmental conservation technology. Large scale geothermal power generation is difficult, medium or small geothermal power plants are of necessity dispersed in each developed geothermal field. At present, geothermal steam power generation is being conducted in comparatively shallow geothermal resources, but larger power plants will be made possible by the development of hydrothermal, deep power generation, and hot dry rock power generation technologies. To promote new types of power generation, large scale geothermal exploration including deep prospecting should be conducted by the government on geothermal fields. This should also provide an estimate of possible future geothermal exploitation, as well as contribute to the scale expansion of geothermal power generation.

DESIGN AND OPERATION

38538 (COO—4051-34) **Geothermal power plants of Italy: A technical survey of existing installations.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth (USA); Brown Univ., Providence, RI (USA)). Oct 1978. Contract EY-76-S-02-4051. 66p. Dep. NTIS, PC A04/MF A01.

The dry-steam geothermal power plants in the Boraciferous (Larderello), Monte Amiata, and Travale regions of Italy are described. The geology of these areas is described along with the nature of the geothermal steam. Details are given about the drilling techniques and the methods used to complete the wells. Noncondensing and condensing steam turbines are described in detail, including special features aimed at improving the flexibility of the machines to meet a variety of geofluid specifications while, at the same time, maintaining high performance. The type of materials used to resist the corrosive and erosive nature of the geothermal fluid are also covered. Economic data and operating experience are presented.

38539 (COO—4051-38) **Geothermal power plants of Iceland: a technical survey of existing and planned installations.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth (USA); Brown Univ., Providence, RI (USA)). Nov 1978. Contract EY-76-S-02-4051. 27p. Dep. NTIS, PC A03/MF A01.

The technical features of the geothermal electric power plants of Iceland are described. Some description is given of the geology of the geothermal regions, and recent volcanic eruptions are discussed relative to their impact on the geothermal plant sites. The 3 MW, single-flash plant at Namafjall, the 60 MW, double-flash plant at Krafla, and the 1 MW unit at Grindavik are included. Information is given on well arrangements, casing programs, energy conversion systems, capital investments, and operating experiences, where such information is available.

38540 (SAN—1137-11) **Geothermal Loop Experimental Facility. Quarterly report, April—June 1978.** Bischoff, W.S.; Bishop, H.K.; Cooney, C.S.; Hanenburg, W.H.; Hoaglin, G.J.; Jacobson, W.O.; Mulliner, D.K.; Newell, D.G.; Swanson, C.R. (San Diego Gas and Electric Co., CA (USA)). Jul 1978. Contract EY-76-C-03-1137. 148p. Dep. NTIS, PC A07/MF A01.

The Geothermal Loop Experimental Facility (GLEF) was modified to use a two stage flash process with two parallel flash trains for the extraction of energy from a high temperature, high salinity, liquid-dominated resource. Since plant start-up in May 1976, a substantial amount of information has been obtained on the operation of the plant, components, brine and steam composition, production and injection wells, and the potential of the Niland Reservoir. The general operation and accomplishments of the GLEF during the period April 1978 through June 1978 are discussed. The GLEF underwent a major redesign. Modifications and inspections of various GLEF equipment and systems are also discussed. Information about the production and injection wells flow testing and instrumentation are discussed. Information regarding coatings and linings for valves and piping is included. In the Chemistry Section

there is a wide range of data taken from Brine, Steam, Scale, Binary, Condensate, and Cooling Water Systems.

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 38528

38541 (COO—4051-35) **Thermodynamic and transport properties of isobutane: a survey of available data.** Kestin, J.; Khalifa, H.E.; Kumar, B. (Brown Univ., Providence, RI (USA). Div. of Engineering). Nov 1978. Contract EY-76-S-02-4051. 204p. Dep. NTIS, PC A10/MF A01.

An extensive compilation of the available equilibrium and transport properties of isobutane (2-methyl propane) is presented. Also, the available correlations of the thermodynamic properties of isobutane are listed; the statement is made that these correlations do not agree among themselves, and that none is obviously superior to the others. This makes it likely that a new correlation as an aid for the design of geothermal installations will be required. The present compilation of available experimental data on equilibrium properties (up to 1978) is a preparatory step towards the formulation of a new, more accurate correlation. A complete bibliography is included.

38542 (ORO—4893-2) **Study and testing of direct contact heat exchangers for geothermal brines. Phase II, August 1976—June 1977.** Suratt, W.B.; Lee, C.O. (DSS Engineers, Inc., Fort Lauderdale, FL (USA)). Nov 1978. Contract EY-76-C-05-4893. 112p. Dep. NTIS, PC A06/MF A01.

The analytical and experimental studies completed under this project have explored several aspects of geothermal binary power cycles and column type direct contact heat exchangers between geothermal brine and isobutane. A major improvement of the heat exchanger was developed by the combination of the preheater and boiler into a single continuous column. At East Mesa, this new direct contact heat exchanger was tested on geothermal brine in order to correlate the experimental heat transfer data with the theoretical model for use in designing larger plants. Experiments also involved a small radial inflow turbine to produce electricity which marked the first generation of electricity from geothermal brine using a binary cycle. In analytical studies, a comparison of the relationship between column diameter and droplet size was made for both Minard—Johnson and Sakiadis—Johnson model. The Letan—Kehat model for relating column height and temperature profile was analyzed and compared with experimental data. It appears that the experimental results are in good agreement with the theoretical models. A detailed design of a 250 Kw pilot plant incorporating the direct contact heat exchanger was completed. This design with estimated costs for it and a 500 Kw pilot plant is incorporated.

38543 (SAN—1137-10) **Geothermal Loop Experimental Facility. Quarterly report, January—March 1978.** Bischoff, W.S.; Bishop, H.K.; Cooney, C.S.; Hanenburg, W.H.; Hoaglin, G.J.; Jacobson, W.O.; Mulliner, D.K.; Newell, D.G.; Swanson, C.R. (San Diego Gas and Electric Co., CA (USA)). Apr 1978. Contract EY-76-C-03-1137. 116p. Dep. NTIS, PC A06/MF A01.

The Geothermal Loop Experimental Facility (GLEF) utilizes a four stage flash/binary process for the extraction of energy from a high temperature, high salinity, liquid-dominated resource. Since plant start-up in May 1976, a substantial amount of information has been obtained on the operation of the plant, components, brine and steam composition, production and injection wells, and the potential of the Niland Reservoir. The general operation and activities of the GLEF during the period January 1978 through March 1978, are discussed. The production and injection well encountered no unusual difficulties. Scrubber performance tests were rerun this period and are discussed. Steam pH, conductivity, chemical composition, brine and scale properties, pigging, and component optimization efforts are discussed. The injection pump difficulties and condenser plugging problems are detailed. The feasibility study for a 50 MWe plant and H_2S abatement are discussed.

38544 **Geothermal energy technology.** *Kogyo Gijutsu;* **19**: No. 9, 28-37(1978). (In Japanese).

Geothermal power plants which are in operation in Japan include Matsukawa, Otake, Onuma, Onikobe, Hatchobara, and Kakkonda, and the Nigorikawa plant is under construction. The Sunshine Project was established to further the development of geothermal energy in Japan with longterm plans concerning excavation and production technologies. These include studies on hot-point areas, deep geothermal resources storage, the investigation of geothermal structure, the development of drilling mud and cement usable under geothermal conditions, the development of down-well prospecting technology, the development of high temperature excavation technology, and the investigation of hot water reinjection. The project is also concerned with hot water utilization techniques including the development of materials and equipment for geothermal power generation and studies on a hot-water power plant or binary cycle plant. Also, volcanic power generation technologies including studies on excavation and fracture of hot-dry-rock and the feasibility of volcanic hot-dry-rock power generation, are included. Multipurpose utilization technologies include the development of scale-prevention techniques and hydrogen sulfide removal techniques. Environmental protection studies include a feasibility study of environmental conservation around a large-scale geothermal power plant.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 38533, 38535, 39195

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 38540, 38541, 38543

38545 (UCRL—52640) **Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field.** Harrar, J.E.; Otto, C.H. Jr.; Deutscher, S.B.; Ryon, R.W.; Tardiff, G.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Factors affecting the precipitation of solids and deposition of scale from the hypersaline brines of the Salton Sea geothermal field - two potential problems in the proposed utilization of these brines for electric power generation - were investigated. The average physical and chemical composition of the fluid from Magmamax No. 1 well was noted and the effects of changes in well flowrate on the chemistry of the brine and the formation of solids were determined. The effects of pH on the process stream chemistry and on the composition and rates of formation of solids and scale that precipitated from this brine were studied. Reduction of the pH from 6 to 4-5 decreased the scaling rates and increased the proportions of bariun sulfate and calcium fluoride in the scales and precipitated solids. These studies were conducted using a small-scale four-stage brine flash system constructed at the site.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 39195

38546 (LBL—7091) **Results of reservoir engineering tests, 1977, East Mesa, California.** Narasimhan, T.N.; Schroeder, R.C.; Goranson, C.B.; Benson, S.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1978. Contract W-7405-ENG-48. 9p. (CONF-781003—6). Dep. NTIS, PC A02/MF A01.

From 53. annual technical conference and exhibition of society of pertoleum engineers; Houston, TX, USA (1 Oct 1978).

The East Mesa KGRA (Known Geothermal Resource Area) is located in the Imperial Valley of Southern California. Geothermal fluids at temperatures of 160°C to 177°C have been successfully tapped by fourteen geothermal wells, ranging in depth from 1800 to 2800m. During 1977 several production and interference well tests were performed on the East Mesa wells in order to assess the reservoir potential. The results of these tests are summarized.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 38520

38547 (LA-UR—79-670) **Federal hot dry rock geothermal energy development program: an overview.** Nunz, G.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790615—9). Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

The formulation and evolution of the Federal Hot Dry Rock Geothermal Energy Development Program at the Los Alamos Scientific Laboratory are traced. Program motivation is derived from the enormous potential of the resource. Accomplishments to date, including the establishment and evaluation of the 5-MW/sub t/ Phase 1 reservoir at Fenton Hill, NM and various instrument and equipment developments, are discussed. Future plans presented include (1) establishment of a 20- to 50-MW/sub t/ Phase 2 reservoir at Fenton Hill that will be used to demonstrate longevity and, eventually, electric power production and (2) the selection of a second site at which a direct thermal application will be demonstrated.

38548 (LA-UR—79-683) **Future of hot dry rock geothermal energy systems.** Smith, M.C. (Los Alamos Scientific Lab., NM

(USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790615—12). Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Where natural groundwater circulation does not exist, the obvious method of extracting heat from the earth's crust is to imitate nature by creating it. A means of doing so by hydraulic fracturing has been demonstrated. Alternatively, explosives or mechanical or chemical methods might be used to open circulation paths. However, where permeabilities are sufficient so that fluid loss is excessive, other approaches are also possible. The magnitude and distribution of hot dry rock and the variety of possible heat-extraction techniques make it appear inevitable that this energy supply will eventually be used on a large scale.

DIRECT ENERGY UTILIZATION

38549 Report of the Geothermal Utilization Committee. Seikieka, M. (Geothermal Energy Utilization Committee, Japan); Naoe, M.; Ito, Y.; Ozawa, T.; Kaneko, Y.; Sato, K.; Sumi, S.; Takagi, S.; Minohara, Y.; Yuhara, K. *J. Jpn. Geotherm. Energy Assoc.;* **14**: No. 1, 7-12(1977). (In Japanese).

The Geothermal Energy Utilization Committee considered the development of new multipurpose uses for geothermal hot water in 1974 and 1975. In 1974, these uses were investigated: the treatment of domestic animal droppings and excretions, the application of power plant waste water to the fishery industry, and the use of hot water to thaw snow in the Joetsu Shinkansen. In 1975, heating and cooling technology was also considered. These uses included, thawing snow along the Jozankei road, the use of a heat pump to recover heat from warm water, and the development of a multi-effect still. Polybutene pipes were laid along the Jozankei road and sidewalks for 183.5 m. A constant temperature was maintained all year, but the system was limited to the hot spring area and did not solve regional problems. The multi-effect stills which utilize geothermal hot water are the triple-effect type with a compressor, the double-effect and single-effect type, and the single-effect-times-three type. These vary according to the amount and temperature of hot water. Of these, the double-effect and single-effect types are considered usable for the concentration of milk and the desalination of seawater, but more thorough technical and economic examinations are required. Five figures and three tables are provided.

38550 (NMEI—13) **Geothermal application feasibility study for the New Mexico State University campus. Technical report.** Gunaji, N.N.; Thode, E.F.; Chaturvedi, L.; Walvekar, A.; LaFrance, L.; Swanberg, C.A.; Jiracek, G.R. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Dec 1978. 127p. New Mexico State Univ., Las Cruces.

The following are covered: a geothermal prospect conceptual study for NMSU campus, geothermal resources on and near NMSU land, present campus heating and cooling system, conceptual design and preliminary cost estimates - alternative systems, economic analysis, and legal and environmental considerations. (MHR)

38551 Method for using geothermal energy. Gill, G.H. US Patent 4,085,795. 25 Apr 1978. Filed date 10 May 1976. 5p.

Geothermal energy is used to provide the temperatures and pressure necessary for catalytic conversion of carbon monoxide and hydrogen to methanol by lowering the reaction chamber into a geothermal well, or by otherwise using geothermal fluids to supply heat and pressure to the reaction chamber. (Author)

38552 Recent developments in geothermal multipurpose utilization in Jozankei Hot Springs in Sapporo City. Sato, M. (Sapporo City Office, Japan); Sekioka, M. *J. Jpn. Geotherm. Energy Assoc.;* **14**: No. 3, 1-7(1977). (In Japanese).

Multipurpose utilization of thermal waters includes snow removal along the Jozankei road. Polybutene pipe 25 to 40 mm in diameter is used instead of 2 1/2 in. galvanized steel pipe which was formerly used and suffered severe corrosion. In 1976, the snow-removal system reached a total length of 1215 m. A fish culture experimental station utilizing a mixture of hot spring water and brook water was completed and is scheduled to begin operation for three years. Also, hotels and inns in the Jozankei area are heated with hot spring water instead of conventional oil heat. Thermal water is also used in bath houses and public restrooms. Fourteen figures and six references are provided.

GEOTHERMAL DATA AND THEORY

PROPERTIES OF MINERALS AND ROCKS

38553 Thermal properties of rocks and heat extraction from hot dry rocks. I. Matsunaga, T. (National Institute for Pollution and Resources, Japan). *Saiko To Hoan;* **23**: No. 11, 11-26(1977). (In Japanese).

In order to extract heat energy from hot-dry-rock systems, it is important to know the thermal porperties of the rocks. These properties include the linear expansion coefficient, Young's modulus, thermal conductivity, specific heat, and thermal diffusivity. New data are presented on the thermal properties of rocks and measuring methods for these thermal properties. Included are the measured and calculated values for the volumetric thermal expansion coefficient by Richter and Simmons, the thermal expansion coefficient differences, shearing stresses, the porosity of two species of minerals by Nur and Simmons, the thermal expansivity difference with the dimensions of grain by Kuszyk and Bradt, and the development of cracks by heating by Murase and McBrirney. Also included are: the measurements of the thermal conductivity of 166 species of rocks composing the crust and upper mantle by Horai, and the measurements of the thermal diffusivity of rocks by Lindroth. Twenty-two figures, 5 tables, and 49 references are included.

TIDAL POWER

38554 (PB—286671) **Harnessing tidal energy. Current issue outline.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Aug 1978. 15p. NTIS PC A02/MF A01.

About 3,000,000 megawatts (MW) of power are continuously dissipated through the motion of the tides over the surface of the Earth. Because of physical limitations, only 2% of this may ever be harnessed. This amounts to about 5% of the present worldwide power generation from all sources. Thus, this inexhaustible power source can make a small, but significant, contribution. The background and fundamental principles of tidal power are discussed and recent developments are given. A selected listing of some of the published material relating to electrical power generation from tides is included.

TIDAL POWER PLANTS

38555 Review of optimization and economic evaluation of potential tidal power developments in the Bay of Fundy. Furst, G.B.; Swales, M.C. (Tidal Power Consultants Ltd., Montreal, Canada). *Can. Electr. Eng. J.;* **4**: No. 1, 17-25(Jan 1979).

This paper presents some results of the Bay of Fundy tidal power potential reassessment studies carried out during 1976—77. A brief description is given of the analytical approach to energy production modelling and optimization studies for the three most attractive sites. The system modelling used for studying integration of tidal generation into the Maritime Integrated Power Systems is reviewed and some preliminary results of the economic evaluation of tidal power sites are presented.

DESIGN AND OPERATION

38556 Tidal power plant and method of power generation. Woodman, H.R. US Patent 4,098,081. 4 Jul 1978. Filed date 14 Feb 1977. 4p.

A plurality of tidal chambers are filled in succession during rising tide and then are allowed to sequentially empty during the half-cycle of falling tide. Power is generated by air flow across a turbine, as a manifold and valve means communicate air pressure from the tidal chambers during rising tide and vacuum pressure during falling tide. Sequential operation of the tidal chambers permits continuous generation of power during the full cycle of rising and falling tide.

WAVE ENERGY CONVERTERS

38557 Apparatus for extracting energy from wave movement of the sea. Cockerell, C. (to Wavepower Ltd.). US Patent 4,098,084. 4 Jul 1978. Priority date 28 Apr 1975, United Kingdom of Great Britain and Northern Ireland (UK), 8p.

This invention relates to apparatus for extracting energy from movement of water, particularly sea waves, the apparatus comprising a plurality of buoyant members which are interconnected one with another so as to be movable relative to one another, each buoyant member being provided with a plate or plate-like member which is supported from the buoyant member and positioned so that in use of the apparatus it is submerged below the level of the water, and means are provided for converting the relative movement of the buoyant members into useful energy, such as electricity.

38558 Wave power generator. Thorsheim, I. US Patent 4,145,882. 27 Mar 1979. Filed date 14 Dec 1977. 4p.

A device for deriving power from the energy of moving water waves includes a bag of flexible, impervious and inelastic material filled with a liquid to at least half but less than full capacity thereof and being adapted for submergence below the surface of a body of water parallel to the principle direction of movement of the waves. A passageway element having open opposite ends is in communication with the interior of the bag and forms together therewith a closed circuit flow as the liquid is channeled between opposite ends of the bag in a direction opposite the principle direction of movement of the waves. An electric power generator with turbine blades thereon is disposed between opposite ends of the passageway element. The liquid within the bag is subjected to an undulating motion between its ends in response to the movement of the waves in such direction as the weight of the waves creates corresponding currents of liquid within the bag, the currents of liquid thereby operating the turbine blades upon the movement of the liquid waves between the ends of the passageway element.

38559 Wave motor. Solell, Y. US Patent 4,145,885. 27 Mar 1979. Priority date 23 Sep 1977, Israel, 6p.

A wave motor is described comprising a float, a displaceable member coupled to the float so as to be displaced by the ascent and descent of the float, a pair of shafts, and a transmission including a pair of one-way clutches coupling the displaceable member to the shafts to rotate one in one direction during the ascent of the float and to rotate the other in the opposite direction during the descent of the float. In one described embodiment, the displaceable member is a wheel which is partially rotated in opposite directions by the ascent and descent of the float; and in a second described embodiment, the displaceable member is a rack which is moved upwardly by the ascent of the float and downwardly by its descent.

38560 Device for deriving power from wave energy. Moody, G.W.; Wilson, J.L. (to Secretary of State for Energy in Her Britannic Majesty's Government). US Patent 4,139,984. 20 Feb 1979. Priority date 18 Aug 1976, United Kingdom of Great Britain and Northern Ireland (UK), 8p.

A device for extracting energy from wave energy and comprising a plurality of chambers adapted for pressurizing and discharging a working gas, means for collecting the pressurized working gas, and a mechanical device such as an air turbine to which the collected pressurized working gas is conducted to extract energy therefrom and drive a device such as an electric generator. The pressurized working gas may be collected in a duct which connects the chambers in parallel relationship and is provided with means for applying a smoothing pressure to smooth out pressure fluctuations of the pressurized working gas. Alternatively, the chambers may be connected together in series relationship so that the pressurized working gas from one chamber is collected by an adjacent chamber as it progresses along the series to the mechanical device.

38561 Preliminary considerations on wave motion measurements. enel's wave meter network. Cavaleri, L.; Rossi, G. (CNR, Lab per lo Stud della Din delle Grandi Masse, Venice, Italy). *Energ. Elettr.;* **55**: No. 5, 213-216, 217-221(May 1978). (In Italian).

This paper describes ENEL's wave meter network along the Italian coast, as well as the recordings so far obtained. The two methods of analysis used--manual and spectral--are shown, with relevant comparison of results. Data of an exceptional sea storm which occurred at Termini Imerese in December 1974 are given.

WIND ENERGY

REFER ALSO TO CITATION(S) 38350

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 38563

38562 (SAND—78-1620) **Wind power climatology of the United States: supplement.** Reed, J.W. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract AC04-76DP00789. 85p. Dep. NTIS, PC A05/MF A01.

This supplement extends the summaries in the earlier Wind Power Climatology of the United States to include monthly and annual average wind speeds. Station histories that allow adjustment for local air density, based on station pressure-altitude and the annual temperature cycle, have been obtained from the National Climatic Center. The logs of anemometer exposures have been used to adjust both wind speeds and wind powers to standard height, 10 m above ground. Extrapolations for speed and power at 20- and 50-m heights have also been provided. Data adjustments to 10-m heights have not significantly changed the original isodyn contour maps except in the Northeast and Northwest coastal areas.

ECONOMICS

38563 (SERI/TP—51-158) **Status of information for consumers of small wind energy systems.** Weis, P. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 19p. (CONF-781235—3). Dep. NTIS, PC A02/MF A01.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

Although competition from cheap fuels has limited their widespread use, wind energy systems are a solar technology that has performed successfully for decades. Renewed interest in this solar technology in both the public and private sector has produced a wide variety of designs suitable for many applications. This paper summarizes past research efforts, existing information sources, and ongoing work to improve data necessary for potential consumers of small wind energy conversion systems.

WIND ENERGY ENGINEERING

APPLICATIONS

REFER ALSO TO CITATION(S) 38484

TURBINE DESIGN AND OPERATION

38564 (SAND—79-0431) **User's manual for the compuer code PAREP.** Leonard, T.M. (New Mexico Univ., Albuquerque (USA)). Apr 1979. Contract EY-76-C-04-0789. 58p. Dep. NTIS, PC A04/MF A01.

PAREP (PArametric REPresentation), a computer code that uses numerical and empirical data to estimate the aerodynamic performance of Darrieus-type vertical axis wind turbines, is discussed. Both program theory and usage are described for the code. Sample runs and program listings are provided.

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 38563

ELECTRIC POWER ENGINEERING

38565 (CONF-7708110—) **Contributions: power plants, 1977.** (VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). 1977. 649p. (In English and German). Dep. NTIS (US Sales Only), PC A99/MF A01.

From VGB international congress on power stations; Copenhagen, Denmark (30 Aug 1977).

The fifty papers presented at the conference are compiled. The topics discussed concerned primarily the construction, operation, and control of nuclear and fossil-fuel power plants. Emission control and environmental aspects of the operation of power plants were also discussed. (JSR)

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 38051, 38409, 39135, 39136, 39138

38566 (AD-A—057405) **Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1.** McCone, A.I.; Johnson, G.G.; Mackewicz, W.V.; Brunner, J.A.; Ruby, J.D. (Bechtel National, Inc., San Francisco, CA (USA)). May 1978. Contract N68305-77-C-0003. 88p. NTIS PC A05/MF A01.

This report analyzes the cost effectiveness of electric power generation at two Navy bases using existing boilers and turbine-generator systems. This study focused on cogeneration which occurs when steam from the power generation turbine can be used to satisfy heating and process steam demands. It was found that cogeneration is the most cost effective means of electric power generation. In contrast, condensing generation is less efficient than power supply from a public utility, and it is usually more expensive. However, occasional use of condensing generation for peak shaving is warranted because it reduces the demand charge. Application of these findings at Philadelphia Naval Shipyard could save up to $800,000 per year in fuel plus electricity purchases. Capital operating and life

cycle costs for new facilities show that it is not economical to install new electric power generation facilities at Navy bases if oil is used.

38567 (AED-Conf—78-155-017) **Increased productivity in power plants by the computer-based information system PRAUT.** Hanbaba, P. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 25p. (In German). (CONF-7804102—28). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

Decrease of commissioning times, reduction of shut-down periods, avoiding of power reductions, fast adaption to load requirement variations act in the direction of increasing the productivity of a power plant. An essential contribution to this is provided by harmonized control, monitoring and communications concepts as realized, e.g. in the PRO-CONTROL system by Brown Boveri.

38568 (AED-Conf—78-155-024) **Design and testing of power plant controls by means of simulation.** Wilhelm, H. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 14p. (In German). (CONF-7804102—31). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

Simulation today is a very effective tool in the hand of the measuring and control engineer but also of the mechanical engineer for development, design, and operation of complex facilities like power plants. It offers the following advantages: - Assessment of plant behavior and early consultation for customers in the stage of bidding - Testing and design of control concepts in the stage of planning - Shortening of the commissioning stage.

38569 (N—78-28387) **Measurement of pulverized fuel flow to burners using an acoustic technique.** Cook, R.F. (Central Electricity Generating Board, London (UK)). Apr 1976. 3p. NTIS PC A02/MF A01.

An acoustic technique to measure the flow of pulverized fuel to burners in power stations is presented. A piezoelectric transducer is mounted on a metal plate located at a bend in the fuel pipe and detects the impact of the particles on the interior wall of the plate and/or excited vibration modes of the plate itself. The output from the transducer gives an indication of the rate of pulverized fuel flow through the pipe. Electronic filtering is used to remove the effect of spurious noise due to, for example, combustion noise, primary air flow and mill rumble. This apparatus has the advantage over other pulverized fuel flow measuring devices (e.g., sampling probes or annular venturi meters) in that it does not suffer appreciable wear from abrasion.

38570 (NP—23706) **Prediction and indication of process states as aids in power plant control technology.** Bauer, K. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Verfahrenstechnik und Dampfkesselwesen). 17 May 1977. 154p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

In order to improve their economics, power plants have become larger, increasingly complex, and automated to a higher degree, thus increasing the demands on control technology. It is shown how the static and dynamic behavior of power plants may be simulated with the aid of predictions and terminals controlled by process computers, using the example of the multivariable system steam generator.

38571 (PB—284676) **Water recycle/reuse alternatives in coal-fired steam-electric power plants. Volume II. Appendixes. Final report June 1975-February 1978.** Noblett, J.G.; Christman, P.G. (Radian Corp., Austin, TX (USA)). Mar 1978. Contract EPA-68-03-2339. 576p.

The report gives results of an investigation of water recycle/treatment/reuse alternatives in coal-fired power plants. Five power plants from representative U.S. regions were studied. The major water systems encountered were cooling, ash sluicing, and SO^2/particulate scrubbers. Results were used to provide general implementation plans for the various options identified. Computer models were used to identify the degree of recirculation achievable in each water system without forming scale. The effects of makeup water quality and various operating parameters were determined for each water system. Several alternatives for minimizing water requirements and discharges were studied for each plant, and rough cost estimates were made for comparison. An implementation plan is presented for each water system and is divided into phases, including system characterization, alternative evaluation, pilot studies, and full-scale implementation. This volume presents detailed studies for each plant, plant selection methodology, laboratory ash sluicing studies, kinetics for $CaCO^2$# and Mg(OH)2 precipitation, and model descriptions.

38572 **Optimum hydrothermal electric energy system scheduling: challenges and opportunities in research and development in Canada.** El-Hawary, M.E. (Memorial Univ. of Newfoundland, Canada). *Can. Electr. Eng. J.*; 4: No. 1, 33-36(Jan 1979).

Some Canadian research and development needs in the area of optimum scheduling of hydro and thermal plants in integrated electric energy systems are discussed. The basic ingredients of some fundamental scheduling problems are highlighted first. This is followed by a discussion of potential directions for theoretical research aimed at improvements in the currently available methodology and algorithms. Opportunities for hardware development for on-line and off-line implementation are also outlined.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

38573 (NP—23707) **Standardized calculation of cooling towers.** Harting, P.E. (Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). 1 Jul 1977. 114p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

Thesis.

For a standardized calculation and assessment of the basic cooling tower types, methods are given for calculating the evaporation characteristics as a characteristic cooling tower value for counterflow and crossflow systems. For the crossflow cooling tower, an optimization method is given which will permit statements on the changes in the geometry of cooling tower intervals. Finally, a method is presented for calculating the evaporation characteristics and the off-air for natural-draft cooling towers; both of these figures are strongly dependent on wind velocity and on the climatic seasonal conditions.

38574 (PB—285126) **Water for power plant cooling.** (California Dept. of Water Resources, Sacramento (USA)). Jul 1977. 54p. NTIS PC A04/MF A01.

Future demands for cooling water needed for the production of electrical energy; possible sources of cooling water, including agricultural and municipal waste water, brackish and saline interior water, geothermal water, ground water, and fresh surface water; and the various methods of power plant cooling are discussed. Plans by California electric utilities to obtain supplies of cooling water for four proposed inland power plants are noted.

38575 (PB—285397) **Water consumption and costs for various steam electric power plant cooling systems. Final report, October 1977—January 1978.** Hu, M.C.; Pavlenco, G.F.; Englesson, G.A. (Cameron Engineers, Inc., Denver, CO (USA)). Aug 1978. Contract EPA-68-01-4337. 140p. NTIS PC A07/MF A01.

The report gives results of a state-of-the-art study, addressing consumptive water use and related costs of various steam electric power plant cooling systems, the availability of water for all uses by area, and the impact of legal constraints on water use in the U.S.

38576 (PB—285924) **Optimization of design specifications for large dry cooling systems. Final report, June 1975—June 1978.** Rozenman, T.; Fake, J.M.; Pundyk, J.M. (Mid-Pacific Marine Lab., Kaneohe, HI (USA)). Jul 1978. Contract EPA-68-03-2215. 315p. NTIS PC A16/MF A01.

The report presents a methodology for optimizing design specifications of large, mechanical-draft, dry cooling systems. A multivariate, nonlinear, constrained optimization technique searches for the combination of design variables to determine the cooling system with the lowest annual cost. Rigorous formulations are used in calculating heat transfer and fluid flow. All thermal and mechanical design variables of the cooling system components are analyzed. Thermal variables include ambient air temperature, condenser terminal temperature difference, cooling range, and initial temperature difference. Module variables are tube length, number of rows and passes, and fan power. The methodology employs a computer program with major computational blocks written as subroutines. The program optimizes dry towers with either surface condensers or direct-contact jet condensers. Results of detailed parametric and sensitivity analyses are presented. The relationships of design variables, major components, site variables, and utility economic factors to incremental annual costs are examined for 1000 MWe fossil fuel plants at five U.S. sites. Results, presented in both graphs and tables, show that all design variables affect cooling system cost.

38577 **Air radiator cooling tower.** Kazanovich, B.B.; Santurian, G.R.; Fischenko, P.A. US Patent 4,142,579. 6 Mar 1979. Filed date 16 May 1977. 8p.

The invention discloses an air radiator cooling tower comprising a piping system for the supply and removal of water circulating in cooled tubular elements joined into groups by means of tubular girders, an exhaust tower for the circulation of cooling air, and a device for the excitation of oscillations transmitted through direct contact over the surface of the tubular elements and/or the water being cooled. The proposed air radiator cooling tower may be

employed in power engineering for cooling condensers at steam power stations.

38578 Cooling towers, design and plume behavior. Ernst, G. (Univ., Karlsruhe, Germany). pp 229-236 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Advantages and disadvantages of variations on the two basic types of cooling towers, wet and dry, are discussed. Results of studies on plume behavior in natural-draft wet cooling towers (with counter flow) are summarized. A design of a proposed combined wet-dry cooling tower is included. (JGB)

POWER CYCLES

REFER ALSO TO CITATION(S) 38947, 38955

38579 (FE—1806-65) **Development of high temperature turbine subsystem technology to a "technology readiness status", phase II. Progress report, March 1979.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 10 Apr 1979. Contract EX-76-C-01-1806. 38p. Dep. NTIS, PC A03/MF A01.

An order has been placed for the Hot Gas Path Development Test Stand (HGPDTS) exhaust stack and silencer. Fabrication of these assemblies has commenced. The ability to measure tubulence intensity in a fired combustor using a laser doppler velocimeter has been evaluated. A thorough system checkout of the turbine simulator facility has been completed. The two monolithic heat transfer airfoils to be tested in the turbine simulator have been delivered. Local surface Mach number distributors for the first stage nozzle and bucket cascades were obtained from tests in the transonic wind tunnel and results are presented. Retesting of the bucket cascade must be conducted. The Gas Cleanup System overall construction effort is estimated 65% complete and has a May 1979 completion date. Activity relating to the update of the Low Btu Gas Fueled CC Power Plant continues to be directed at the evaluation of a raw gas steam generator in the system. Schematics have been prepared for the extraction air system, the gas fuel system, the hydraulic supply system, the control oil system and the trip oil system for the TRV. An analysis to determine the stresses due to the gas pressure loading in the TRV compressor discharge casing were completed and the results are reported. Heat transfer and stress analyses have been completed for the TRV combustor pilot liner dome. A thermal fatigue analysis for the first stage nozzle trailing edge with a 10 mil wall cooling tube was conducted and is discussed. A detailed vibration analysis is underway for the third stage bucket. The facility for LCF testing of copper alloys in an inert atmosphere is complete. System leak checks are currently being conducted.

38580 Method of operating a power plant and apparatus therefor. Kato, S.;. (to Hitachi, Ltd.). US Patent 4,145,995. 27 Mar 1979. Priority date 14 Jul 1976, Japan, 4p.

The invention relates to the control of the operation of a power plant including a gas turbine power generating unit, a main boiler whose heat source is exhaust gas of the gas turbine and which supplies steam to a heat load, a back-up boiler which has an independent fuel system and which is operated to supply steam to the heat load when the quantity of supply of steam of the main boiler to the load is insufficient, and a heat exchanger which is disposed in a boiler feeding system common to the main boiler and the back-up boiler and which receives excess steam or condensed water as discharged from the heat load and heats feed water, a method of operating a power plant and apparatus therefor comprising a circulating pipe for connecting a steam generating portion of the back-up boiler and the heat exchanger and for causing boiler feed water to flow from the back-up boiler back to the heat exchanger even during shutdown of the back-up boiler, and valve means disposed in the circulating pipe and adapted to be shut when a condition of the generating steam of the main boiler for the heat load is insufficient and when the back-up boiler is operated, whereby the temperature of the steam generating portion of the back-up boiler is held at above a predetermined temperature even during the stutdown of the back-up boiler.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 39047

COMPONENTS

REFER ALSO TO CITATION(S) 38579, 38601, 38964, 38965, 39141

38581 (AD-A—057448) **Electric generator development for the 1980's. Final report July 1975—April 1978.** Uellner, W. (Naval Air Engineering Center, Lakehurst, NJ (USA). Ground Support Equipment Dept.). 15 May 1978. 142p. NTIS PC A07/MF A01.

This report outlines the development of a 400 Hz, 30 KW generator, to be used in a Mobile Electric Power Plant (MEPP). The developed generator complies with the new standard for ground power, MIL-STD-704C. A computer aided design was used to develop engineering generator system parameters from desired specified output requirements. The computer program was fully substantiated by actual test results.

38582 (NTIS/PS—78/0993) **Boiler corrosion (citations from the NTIS data base). Report for 1964-August 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 121p.

Federally-funded research on design, efficiency, materials, cathodic protection, corrosion inhibiting additives, and combustion in coal and fuel oil fired boilers is cited. Studies on limestone injection for pollution control and its effect on boiler corrosion are included. The research also covers boilers in magnetohydrodynamic power generation, ships, and nuclear power plants. (The updated bibliography contains 115 abstracts, 13 of which are new entries to the previous edition.)

38583 (NTIS/PS—78/0994) **Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 192p.

Worldwide research on materials, fuel types, fuel impurities, additives, efficiency, inhibitors, and combustion is cited. Boiler corrosion studies related to pollution control, feedwater treatment, testing, and boiler design are also included. (The updated bibliography contains 186 abstracts, none of which are new entries to the previous edition.)

38584 (NTIS/PS—78/0994/SL) **Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 192p.

Worldwide research on materials, fuel types, fuel impurities, additives, efficiency, inhibitors, and combustion is cited. Boiler corrosion studies related to pollution control, feedwater treatment, testing, and boiler design are also included. (The updated bibliography contains 186 abstracts, none of which are new entries to the previous edition.)

38585 (NTIS/PS—78/0995) **Boiler corrosion. volume 3. 1977-august, 1978 (citations from the engineering index data base). Report for 1977-August 1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 146p.

Worldwide research on materials, fuel types, fuel impurities, additives, efficiency, inhibitors, and combustion is cited. Boiler corrosion studies related to pollution control, feedwater treatment, testing, and boiler design are also included. (The updated bibliography contains 139 abstracts, 83 of which are new entries to the previous edition.)

38586 Liquid-cooled turbine bucket with enhanced heat transfer performance. Dakin, J.T.; Darrow, K.A.; Muth, M.C. (to General Electric Co.). US Patent 4,142,831. 6 Mar 1979. Filed date 15 Jun 1977. 8p.

Individual coolant passages in the airfoil portion of a liquid-cooled turbine bucket are each provided with a plurality of inwardly protruding circumferentially-extending crimps or rings located at spaced intervals along each passage, each crimp, protrusion or ring extending along the inner periphery in a plane generally perpendicular to the wall of the coolant passage at that location. The main flow of liquid coolant moving in each such individual passage during turbine operation under the combined influence of centrifugal and Coriolis forces is broken up and dispersed over an enlarged area of the interior of the coolant passage upon encountering the protrusions.

38587 Multiple-piece ceramic turbine blade. Glenn, R.G. (to Electric Power Research Inst.). US Patent 4,142,836. 6 Mar 1979. Filed date 27 Dec 1976. 4p.

A turbine blade is described that is comprised of at least a pair of abutting blade parts with each part having a root coupled to an attachment piece, the latter adapted to be coupled to a turbine rotor. The blade parts can be curved and each blade part may have a hollow space in the region where it abuts the other blade part to reduce the weight of the blade. The blade parts may be spigoted or mated with tongue and groove structure to reduce fluid leakage through the junction between the blade parts.

38588 Detector and process for determining discontinuity of flow in a gas turbine drive. Elsaesser, F.L.; Hall, J.H. (to United Technologies Corp., Hartford, CT (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,652,728/A/. 26 May 1977. 29p. (In German).

The patent relates to a process, where the temporal coincidence of two events in the operation of a gas turbine drive is used as the criterion for threatened discontinuity of flow. Each of these events to be determined by continuous measurement supplies part of a signal to an AND gate; on simultaneous arrival of both parts of the signal, this circuit gives a warning signal for discontinuity of flow or introduces immediate counter measure into the necessary sequence. In order to avoid spurious alarms due to so called 'wipers' occuring for a short time, the warning signal can be delayed by a short time, i.e. will only occur after the first and/or second part of the signal have existed for some seconds. The first part of the signal is supplied by the fuel regulator, which indicates that the drive is running in an acceleration programme attached to the regulator, i.e. in a transitional condition. A second part of the signal stems from an operating parameter, if this alters abnormally, i.e. in another way (faster or more slowly) than that corresponding to a straightforward alteration of turbine operating conditions. Either the compressor speed or compressor pressure are used as such operating parameters for the second part of the signal. For two-shaft drives, the individual parameters of the LP or HP compressor or a quotient e.g. from both speeds or the pressure between LP and HP compressor can be used as inlet pressure.

38589 **Gas turbine construction and combustion process carried out in gas turbine.** Martin, F.J. (to General Electric Co., Schenectady, NY (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,647,463/A/. 28 Apr 1977. 17p. (In German).

The invention is concerned with the special dimensioning of the combustion chamber of a gas turbine, in which liquid or gaseous fuels with a relatively high fixed nitrogen content are burned, so that the emission regulations (particularly for nitrogen oxides) are complied with. Apart from the first and second combustion zone and a dilution zone, before the turbine, a delay zone is formed in the through cylinder combustion chamber between the first two zones. Air entering via slots, distributed over the whole length protects the cladding against overheating without appreciably contributing to the combustion process. Openings at the beginning and the circumference of the combustion zones let the combustion air flow radially-tangentially into the combustion chamber. Fuel centrally injected into the first zone burns with the corresponding quantity of added air in a pure mixture with an equivalent ratio of between 1.2 and 1.5, i.e. at the limit of combustibility. After completion of primary zone combustion, the reaction products enter the delay zone of the invention without further addition of air. The dwell time determined by their length (approx. 15 to 20cm) at adiabatic flame temperature is sufficient for the conversion of most of the fixed nitrogen into molecular, i.e. harmless nitrogen. Only a small part of nitrogen oxides is formed. Addition of air in the subsequent second combustion zone ensures secondary combustion with weak mixture with an equivalent ratio of between 0.7 and 1.0. A third addition of air in the dilution zone cools the gas flow before entry into the turbine.

ECONOMICS

REFER ALSO TO CITATION(S) 38327, 38338, 38340, 38341, 38342, 38343, 38344, 38345, 38346

38590 (DOE/EIA—0180) **Gas-turbine electric plant construction cost and annual production expenses, 1976. Energy data report fourth annual supplement.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 126p. Dep. NTIS, PC A07/MF A01.

A total of 520 gas-turbine electric plants owned and operated by electric utilities in the United States produced 23.580 billion kWh during calendar year 1976, up from the net 1975 production of 22.436 billion kWh. The installed capacity of these gas-turbine electric plants at the end of 1976 was 46,576 MW, up 5.6% from the 44,106 MW in 1975. The total installed capacity of the 354 gas turbine electric plants in the United States included in this report was 37,891 MW at the end of 1976, and their net generation for that year totaled 16.838 billion kWh. These plants account for approximately 81.4% of the total installed gas-turbine electric plant capacity and 71.4% of the net gas-turbine generation in 1976. Generation and capacity data of all gas-turbine electric plants, and of the larger plants listed in this report are tabulated.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 38837, 38838

FUELS

REFER ALSO TO CITATION(S) 38129, 39346, 39348

38591 (HCP/M2098—02) **Comparison of projected electric-utility peaking-gas-turbine energy requirements to potential alcohol fuels availability: 1980—2000.** (Mueller Associates, Inc., Baltimore, MD (USA)). Mar 1979. Contract EX-76-C-01-2098. 43p. Dep. NTIS, PC A03/MF A01.

Difficulties exist in predicting future alcohol availability for fuel purposes principally because there is little historical information to draw from; the alcohol fuels "industry" (in the United States) is not as widespread or well-established as other fuels-producing industries. Despite these difficulties, various organizations have developed projections of both alcohol fuels production and the energy required by utility peaking gas turbines. These projections are reviewed and the results indicate (without regard to market supply/demand factors) that alcohol fuels could provide a significant percentage (45 to 55%) of the energy requirements for electric-utility gas turbines as early as 1985 if pursued on a high-priority basis--and 100% of the projected gas-turbine energy requirements could be satisfied by 1987. The economics of alcohol fuels production (though not addressed in this report), especially with respect to optimizing the mix of alcohol fuels production (e.g., the relative percentage of alcohol fuels from wood, coal, and agricultural products), will certainly bear on the financial practicality of utilizing alcohol fuels for utility peaking turbines. Another related factor is the seasonal production of alcohol fuels and its match with the relatively seasonal usage of peaking gas turbines. Also, the problem of converting fuel delivery and storage systems to handle alcohol fuels must be considered.

38592 (SAN—1543-12) **Fundamental characterization of alternate fuel effects in continuous combustion systems.** Blazowski, W.S.; Edelman, R.B.; Harsha, P.T. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.; Science Applications, Inc., Woodland Hills, CA (USA)). 11 Sep 1978. Contract EC-77-C-03-1543. 86p. Dep. NTIS, PC A05/MF A01.

The overall objective of this contract is to assist in the development of fuel-flexible combustion systems for gas turbines as well as Rankine and Stirling cycle engines. The primary emphasis of the program is on liquid hydrocarbons produced from non-petroleum resouces. Fuel-flexible combustion systems will provide for more rapid transition of these alternate fuels into important future energy utilization centers (especially utility power generation with the combined cycle gas turbine). The specific technical objectives of the program are to develop an improved understanding of relationships between alternate fuel properties and continuous combustion system effects, and to provide analytical modeling/correlation capabilities to be used as design aids for development of fuel-tolerant combustion systems. Efforts this past year have been to evaluate experimental procedures for studying alternate fuel combustion effects and to determine current analytical capabilities for prediction of these effects. Jet Stirred Combustor studies during this period have produced new insights into soot formation in strongly backmixed systems and have provided much information for comparison with analytical predictions. The analytical effort included new applications of quasi-global modeling techniques as well as comparison of prediction with the experimental results generated.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38348, 38865, 39550, 39556, 39557, 39559, 39586, 39587, 39616, 39695

38593 (PB—284075) **Chalk point cooling tower project: cooling tower effects on crops and soils. preoperational report. Report for April 1973—April 1975.** Mulchi, C.L.; Wolf, D.C.; Foss, J.E.; Armbruster, J.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Mar 1976. 108p. NTIS PC A06/MF A01.

The objectives of the Chalk Point Cooling Tower Project are to monitor the effects of saline aerosol drift originating from the stacks and natural draft cooling towers associated with Units No 3 and 4 at the Chalk Point Electric Generating Station operated by PEPCO. This report summarizes baseline dustfall and SO^2 data obtained on a monthly basis over the period April, 1973 - April, 1975 from 12 monitoring sites. Each monitoring site is approximately 0.4 ha in area and has three replicated plots established for monitoring yields and chemical characteristics of major agricultural crops (corn, soybeans, tobacco, wheat, oats, barley), dustfall collectors, sulfation plates, a raingauge and an undisturbed site for monitoring changes in the chemical and physical properties of soils. (Color illustrations reproduced in black and white)

38594 (PB—284076) **Chalk point cooling tower project: cooling tower effects on crops and soils. Preoperational report, appendix. Report for April 1973—April 1975.** Mulchi, C.L.; Wolf, D.C.; Foss, J.E.; Armbruster, J.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Apr 1976. 97p. NTIS PC A05/MF A01.

This report contains data collected on a monthly basis over the period April, 1973 - April, 1975 for dustfall particulates, sodium and chloride and SO2 levels obtained from 12 monitoring sites near the Chalk Point Generating Station operated by PEPCO and located 65 km south-southeast of Washington, D.C. on the Patuxent River in Maryland. Information on rainfall amounts, acidity and salinity; soil chemical analyses; yield and quality of major crops; and chemical analyses of vegetative samples from seven crop species for 1973 and 1974 growing seasons are reported. Also included in this report are summaries of experiments conducted at the Tobacco Experimental Farm near Upper Marlboro, Md. involving the simulation of salt spray drift on tobacco, corn and soybeans. Crops yields and quality and chemical analyses of vegetative samples are reported.

38595 (PB—284077) **Chalk point cooling tower project: cooling tower effects on crops and soils. Postoperational report No. 1, Volume 1. Final report, May 1975—April 1976.** Mulchi, C.L.; Wolf, D.C.; Foss, J.E.; Armbruster, J.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Jun 1976. 61p. NTIS PC A04/MF A01.

The natural draft cooling tower on Unit No 3 at the Chalk Point Generating Station, operated by PEPCO, became operational in July, 1975. This report contains a summary of information obtained on a monthly basis over the period May, 1975 - March, 1976 for dustfall particulates, sodium and chloride; SO2; rainfall amounts, acidity and salinity; yields and quality for major agricultural crops (corn, tobacco and soybeans); and chemical analyses of vegetative and soil samples obtained during the 1975 growing season. Several years of data appears necessary before specific effects due to salt drift can be assessed.

38596 (PB—284078) **Chalk point cooling tower project: cooling tower effects on crops and soils. postoperational report no. 1, volume 2. Final report May 1975-April 1976.** Mulchi, C.L.; Wolf, D.C.; Foss, J.E.; Armbruster, J.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Jun 1976. 38p. NTIS PC A03/MF A01.

This report contains summaries of experiments involving the effects of simulated salt drift on corn, tobacco and soybeans which were conducted during the summer of 1975 at the Tobacco Experimental Farm near Upper Marlboro, Md. Brackish water utilized in these studies was obtained from the Unit No 3 cooling tower at Chalk Point Generating Station opened by PEPCO. The water, which varied in total salinity from 8.6 to 14.0 ppt, was applied as 100 micron droplets for five days per week for eight weeks at rates of 0, 17.1, 34.2 and 51.3 l/ha/day. When treatments were terminated, yields and chloride contents of cured tobacco were found to be increased by treatments. Also contained in this report are results from studies concerning the effects of nitrogen sources on the response of tobacco to soil chloride additions. Trends for increased yields and values were found with increased soil chloride additions and for nitrate nitrogen. Leaf burn was negatively correlated with leaf chloride levels. Data on the movement of NaCl through soils and the effects of salt-sprayed soybean residue on soil respiration rates was presented and discussed.

38597 (PB—284094) **Chalk point cooling tower project: cooling tower effects on crops and soils. post operational report no. 2. Final report FY 1977.** Mulchi, C.L.; Wolf, D.C.; Foss, J.E.; Armbruster, J.A. (Maryland Univ., College Park (USA). Water Resources Research Center). Aug 1977. 139p. NTIS PC A07/MF A01.

This report contains a summary of monthly dustfall, SO^2, rainfall, crops and soils information obtained over the period May, 1976 to March, 1977 from 12 monitoring sites near the Chalk Point Generating Station operated by PEPCO which is located 65 km south-southeast of Washington, D.C. on the Patuxent River in Maryland. The report also contains a comprehensive comparison of monitoring data collected over two-year periods prior to and following, respectively, the initiation of operations of Unit No 3 natural-draft cooling tower at Chalk Point. Chemical analyses of vegetative and soil samples collected following initiation of cooling tower operations have been variable with some increases in tissue chlorides in crops being observed. Changes in crop yields have been more attributable to natural environmental conditions than to salt stress.

38598 (PB—284214) **Chalk point cooling tower project: effects of simulated saline cooling tower drift on woody species. Master's thesis.** Francis, B.A. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Jul 1977. 87p. NTIS PC A05/MF A01.

Cooling towers of power plants are used to dissipate waste heat into the atmosphere. If saline water is used for cooling, a saline aerosol known as drift is released into the atmosphere. Drift effects on vegetation are not well known. To simulate drift for a field study, cooling tower basin water was sprayed thirty separate times during a 46-day period in 1975 on Virginia pine (Pinus virginiana), flowering dogwood (Cornus florida), tulip tree (Liriodendron tulipfera), and California privet (Ligustrum ovalifolium), Norway spruce (Picea abies), and white ash (Fraxinus americana) were added in 1976 and all trees were sprayed 43 times during a 59-day period. Only dogwood leaves showed significant injury. Absence of injury on other species was probably due to the ability of their leaves to exclude, or reduce absorption of, toxic concentrations of the ions supplied.

38599 (PB—286024) **Comprehensive standards: the power generation case.** Pigford, T.H.; Keaton, M.J.; Mann, B.J.; Cukor, P.M.; Sessler, G.L. (Teknekron, Inc., Berkeley, CA (USA). Energy and Environmental Engineering Div.). Jun 1978. Contract EPA-68-01-0561. 337p. NTIS PC A15/MF A01.

This study presents an illustrative data base of material quantities and environmental effluents in the fuel cycles for alternative technologies of thermally generated power. The entire fuel cycle for each of the alternative ten technologies is outlined for a representative power plant generating 1000 Mw of electrical power. The required utilization of material resources and the fuel-cycle material quantities are indicated on a flow sheet for each technology. The technologies considered are: (1) Light Water Nuclear Reactor; (2)Coal: Appalachian Bituminous and Northwestern Sub-bituminous; (3) Residual fuel oil; (4) Natural Gas; (5) High Sulfur Coal, with Coal Gasification and Sulfur Removal; (6) High Sulfur Coal, with SO2 recovery by Wet-Limestone Scrubbing; (7) Geothermal Steam; (8) Breeder Fission Reactor; (9) Solar Energy; and (10) Thermonuclear Fusion.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 39623

38600 (PB—285098) **Proposed issuance of a new source national pollutant discharge elimination system permit and section 10 and section 404 permits to Iowa Southern Utilities Company, Ottumwa generating station. Final environmental impact statement.** (Environmental Protection Agency, Kansas City, MO (USA). Region VII; Army Engineer District, Rock Island, IL (USA); Black and Veatch, Kansas City, MO (USA)). Aug 1978. 756p. NTIS PC A99/MF A01.

The U.S. Environmental Protection Agency (EPA) is considering the issuance of a new source of National Pollutant Discharge Elimination System (NPDES) permit (P.L. 95-217, Section 402) for discharge of wastewaters from Iowa Southern Utilities' proposed Ottumwa Generating Station (OGS). Pursuant to the National Environmental Policy Act of 1969 (P.L. 91-190), EPA has prepared this environmental impact statement (EIS) to evaluate the potential impacts of this action on the Des Moines River, the cities of Chillicothe and Ottumwa, and the surrounding areas. This EIS is a multiagency document prepared in conjunction with the U.S. Army Corps of Engineers. It will serve as the Corps of Engineers' EIS in the issuance of a Section 10, River and Harbors Act permit. The proposed site for the 727 megawatt coal-fired steam-electric generating station is located adjacent to the Des Moines River approximately 8 miles northwest of Ottumwa, Iowa. Its estimated cost is $300 million. OGS will utilize a closed-cycle cooling system and will require make-up water at a rate of 17 cfs at maximum load conditions. Total discharge to the Des Moines River is estimated to be 1.4 cfs at maximum load conditions. Low sulfur western coal will fuel the plant at a rate of 2,200,000 tons per year. Principal constituents of the plant stack emissions are particulate matter, sulfur oxides, nitrogen oxides and various trace elements. An electrostatic precipatator will be used to control particulate matter. Selection of low sulfur coal will minimize SO2 emissions, and furnace design will control NO2.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 38046, 38095, 39045

38601 (BNL—25587) **Laser-particulate control for open-cycle, coal fired gas turbines.** Botts, T.E.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790305—3). Dep. NTIS, PC A02/MF A01.

From ASME gas turbine closed-cycle session; San Diego, CA, USA (11 Mar 1979).

Direct coal-fired gas turbines need efficient, high-temperature, particulate control in order to be an attractive option for the efficient conversion of coal to electrical energy. Particulates in the range of three to ten microns are very difficult to remove; and it is, therefore, proposed that they be fragmented into particulates below the threshold size for turbine blade erosion using pulsed CO_2 lasers. Beam interaction with combustion products is considered. A 1000 MW(e) conceptual plant is presented to demonstrate costs and recirculating power requirements.

38602 (PB—284045) **Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April—December 1977.** Devitt, T.; Gerstle, R.; Gibbs, L.; Hartman, S.; Klier, R. (PEDCO-Environmental, Inc., Cincinnati,

OH (USA)). Mar 1978. Contract EPA-68-02-2603. 44p. NTIS PC A03/MF A01.

The report discusses the availability of technology for reducing SO^2 emissions from coal-fired steam generators using flue gas desulfurization (FGD) systems. Foreign and domestic lime, limestone, double alkali, magnesium slurry, and Wellman-Lord FGD systems are described, and the design parameters and operating experiences are discussed. Steps that have been taken to achieve high system operability are discussed. Also, disposal of FGD system wastes is discussed briefly.

38603 (PB—284452) **Rapping reentrainment in a near full scale pilot electrostatic precipitator. Final report May 1975-April 1978.** Nichols, G.B. (Southern Research Inst., Birmingham, AL (USA)). Jun 1978. Contract EPA-68-02-1875. 24p.

The report gives results of a research program to identify the characteristics of particulate matter reintroduced into a gas stream flowing through an electrostatic precipitator (ESP) attributable to collection electrode rapping. The study included both fundamental and experimental studies of dust layer behavior in a pilot-scale ESP with collection electrodes of a size that approximates those in a full-scale field unit. Results of the pilot study, together with those of a related study of full-scale ESPs collecting flyash from coal-fired boilers, were used to modify the EPA Computer Systems Model of an ESP to more nearly represent the actual behavior of this class of particulate control device.

38604 (PB—285723) **CEA variable-throat venturi scrubber evaluation. Final report, May 1977—December 1977.** McCain, J.D. (Southern Research Inst., Birmingham, AL (USA)). Jun 1978. Contract EPA-68-02-1480. 81p. NTIS PC A05/MF A01.

The report gives detailed results of fractional and overall mass efficiency tests of a Combustion Equipment Associates(CEA) variable-throat venturi scrubber. The tests were performed on a full-scale scrubber used for controlling particles and SO/sub x/ emissions from a pulverized-coal-fired utility boiler. Total flue gas particulate mass concentrations were determined at the scrubber inlet and outlet by conventional techniques. Inlet and outlet particulate concentrations as functions of size were determined on a mass basis using cascade impactors for sizes from about 0.3 to 5 μ, and on a number basis for sizes smaller than about 1 micrometer using optical and electrical mobility techniques. The report describes the scrubber, measurement methods, inlet and outlet size distribution data, and fractional efficiencies.

38605 (PB—285854) **Review of new source performance standards for coal-fired utility boilers. Volume I. Emissions and non-air quality environmental impacts.** (Teknekron, Inc., Berkeley, CA (USA). Energy and Environmental Engineering Div.). Mar 1978. Contract EPA-68-01-1921. 136p. NTIS PC A02/MF A01.

This two volume report summarizes a study of the projected effects of several different revisions to the current New Source Performance Standard (NSPS) for sulfur dioxide (SO^2) emissions from coal-fired utility power boilers. The revision is assumed to apply to all coal-fired units of 25 megawatts or greater generating capacity beginning operation after 1982. The revised standards which are considered are: (1) mandatory 90% SO^2 removal with an upper limit on emissions of 1.2 lb SO^2 per million Btu; (2) mandatory 80% SO^2 removal with the same upper limit; (3) no mandatory percentage removal with an upper limit of 0.5 lb SO2 per million Btu. In addition, effects of revising the NSPS for particulate emissions from the current value of 0.1 lb per million Btu down to 0.03 lb are quantified. Projections of the structure of the electric utility industry both with and without the NSPS revisions are given out to the year 2000. Volume 1 discusses air emissions, solid wastes, water consumption, and energy requirements.

38606 (PB—286646) **Characterization of carbide lime to identify sulfite oxidation inhibitors. Final report Sep 77-Jul 78.** Holcombe, L.J.; Luke, K.W. (Radian Corp., Austin, TX (USA)). Sep 1978. Contract EPA-68-02-2608. 79p. NTIS PC A05/MF A01.

The report gives results of a study of carbide lime--a by-product of acetylene manufacture, primarily calcium hydroxide--used in a flue gas desulfurization (FGD) system at Louisville Gas and Electric (LGE). The study was undertaken to: identify sulfite ion oxidation inhibitors in carbide lime, and develop an analytical method for sulfite that avoids the interferences observed in analyzing scrubber liquors from LGE's FGD system. Thiosulfate was identified as the oxidation inhibitor in carbide lime; it was also identified (along with other reduced sulfur species) as a source of interference in the iodine titration method used at LGE for sulfite analysis. Bench-scale tests verified the presence of thiosulfate as a major inhibition to sulfite oxidation in simulated scrubber liquors. This means that the low oxidation rate (e.g., that reported at LGE with carbide lime) results in a greatly reduced tendency to calcium sulfate (gypsum) scaling, therefore a greatly improved FGD system reliability. The amount of thiosulfate required for scale-free scrubber operation is unknown. However, to bring the thiosulfate level of commercial lime up to that found in carbide lime would cost $1.50 per ton of lime (using sodium thiosulfate pentahydrate at $12 per 100 pounds). The ion chromatograph was found to be the best analytical tool for determining sulfite concentrations in carbide lime liquors.

38607 **Process for removing sulfur dioxide from waste gases.** Ratcliffe, C.T.; Pap, G. (to Allied Chemical Corp.). US Patent 4,140,752. 20 Feb 1979. Filed date 25 Jul 1977. 4p.

A catalyst/adsorbent is described for sulfur dioxide from waste gases, via oxidation thereof to sulfur trioxide, comprising vanadium oxide supported on activated carbon, promoted by nickel sulfate or potassium sulfate, or preferably by both.

38608 **Carbonaceous fuel combustion with improved desulfurization.** Yang, R.T.; Shen, M. (to Dept. of Energy). US Patent Application 918,618. 23 Jun 1978. 18p.

Lime utilization for sulfurous oxides adsorption in fluidized combustion of carbonaceous fuels is improved by impregnation of porous lime particulates with iron oxide. The impregnation is achieved by spraying an aqueous solution of mixed iron sulfate and sulfite on the limestone before transfer to the fluidized bed combustor, whereby the iron compounds react with the limestone substrate to form iron oxide at the limestone surface. The iron oxide present in the spent limestone is found to catalyze the regeneration rate of the spent limestone in a reducing environment. Thus both the calcium and iron components may be recycled.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 38760, 38926

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 38404, 38933, 38937

38609 (AD-A—058421) **Decomposition and probabilistic simulation in electric utility planning models. Technical report.** Bloom, J.A. (Massachusetts Inst. of Tech., Cambridge (USA). Operations Research Center). Aug 1978. Contracts DAAG29-76-C-0064;E(11-1)-4119. 320p. NTIS PC A14/MF A01.

The paper presents several mathematical programming models for planning expansion of electricity generating capacity by utilities. The objective considered is to minimize the cost of meeting a given set of demands over a multi-period planning horizon. In this formulation, the problem naturally decomposes into two parts - determining the optimal plant capacity investments over the entire horizon and determining the optimal operating schedule for the generating plants in each period. The paper discusses how mathematical programming decomposition techniques can be used to exploit this natural decomposition. The paper also discusses how these models can be used in peak-load pricing.

38610 (COO—4206-5) **Security assessment of power systems including energy storage. Progress report, April 1—June 30, 1978.** Carroll, D.P.; Triezenberg, D.M. (Purdue Univ., Lafayette, IN (USA). Energy Systems Simulation Lab.). Jul 1978. Contract EC-77-S-02-4206. 32p. Dep. NTIS, PC A03/MF A01.

Work has continued on the verification of the simplified model of a force-commutated inductor-converter (IC) unit. This simplified analytical model will be useful in power system studies involving the control applications of magnetic energy storage devices. Computer simulations of a three-bus power system equivalent with both the simplified and a detailed converter representation were compared for verification of the simplified IC model. Work has also continued on the special task involving the application of small IC units for system damping. The BPA equivalent system has been simulated and a comparison has been made with field results taken during the Dynamic Brake test. The IC unit has been incorporated into this simulation and system damping studies have been performed. A set of DIBN noise generators has been constructed from TTL logic packages, and are now used in system simulations. The limitations of least squares schemes for estimation of system parameters have been established. A study is being made of the use of the Yule—Walker equations for parameter calculation from an autocorrelation estimate.

38611 (N—78-28360) **A triggered co-ordinating gap for metalclad substations.** Hampton, B.F.; Meats, R.J. (Central Electricity Generating Board, London (UK)). Jan 1978. 7p. NTIS PC A02/MF A01.

A triggered sphere gap in SF^6 was developed to provide protection against switching overvoltages in metalclad substations. The trigger is activated when the voltage across the gap reaches a predetermined level, irrespective of its waveshape or polarity. Complete breakdown of the gap follows in 3 microsec due to delays in the triggering circuit, but there are prospects of reducing this. Protection against lightning surges at the basic insulation level is

ensured by self-breakdown on the front of the wave. The protective level of the gap is well defined, the difference between the guaranteed withstand and flashover voltages being less than 2%. Since the gap must be replaced after each flashover, it should be used only where the probability of it operating is low. In those situations it could be considered as a small, low-cost alternative to a surge arrester.

38612 (PB—285123) **Response of a latticed transmission tower to wind. Final report.** Laursen, H.I.; Kempner, L. Jr. (Oregon State Univ., Corvallis (USA). Dept. of Civil Engineering; Bonneville Power Administration, Portland, OR (USA)). 29 Sep 1977. 59p. NTIS PC A04/MF A01.

The report describes the procedures used and the results obtained in a study of the response of a latticed steel transmission line tower to wind loading. The test tower, 110 feet in height, is on a 500-kV line and supports 3 twin-bundle conductors. Strong wind recordings, in digital form on magnetic tape, were obtained for stresses in the tower members, load on the tower from the conductors and overhead groundlines, the longitudinal and transverse swing of the insulators, and wind speed and direction. The results indicate the general nature of how the tower responds to wind loading as well as the dynamic response obtained through random data analysis techniques. Stesses measured in the tower are compared with values obtained by the Bonneville Power Administration computerized tower analysis procedure.

38613 (PB—285190) **Analytical modeling techniques of a lattice-type tower. Master's thesis.** Hess, B.W.; Laursen, H.I. (Oregon State Univ., Corvallis (USA). Dept. of Civil Engineering). Apr 1976. 29p. NTIS PC A03/MF A01.

A latticed steel transmission line tower is analytically modeled for computer analyses and the computed member forces are compared with values obtained in the field from a static load test. Axial and bending effects in the members and slip in the joints are considered in the analytical model. The computer programs used in the analyses are SAP IV, NONSAP, and Bonneville Power Administration's tower analysis program.

38614 (SAND—79-0396C) **Dielectric stimulated arcs in lightning arrestor connectors.** Brainard, J.P.; Andrews, L.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-790506—1). Dep. NTIS, PC A02/MF A01.

From 29. electronic components conference; Cherry Hill, NJ, USA (14 May 1979).

Substantial lowering of breakdown voltage can occur between electrodes in air when a solid insulator surface bridges these electrodes. The breakdown mechanism involves a type of surface flashover across the insulator. The apparent triggering of the breakdown by the insulator is called dielectric stimulated arc. This phenomenon, based on previous experimental results, has been incorporated into the lightning arrestor developed by Sandia Laboratories. The lightning arrestor connector would be more useful if both the mean and standard deviation of breakdown levels were decreased. With this goal in mind, several experiments were performed in order to study the dielectric stimulated arc in detail. Pre-breakdown conduction was measured and was shown by image enhanced photography to be caused by partial discharging. The partial discharge was found to occur in high-field regions far from the breakdown site. Ultraviolet light generated by the partial discharge was shown to sympathetically initiate a surface flashover on the insulator within a few tens of nanoseconds. These studies have led to a better understanding of dielectric stimulated arcs and will undoubtedly lead to improved lightning arrestor designs.

38615 **Problems of country power system automation.** Halawa, T.; Koekiewicz, A.; Kowalski, A.; Malkiewicz, J.; Skalski, B. *Energetyka;* No. 12, 489-496(1978). (In Polish).

The directions of the power system automation development including the thermal, hydro and nuclear power stations, transmission and distribution grids and dispatching process on all levels of automation are presented. In particular the systems for exchanged power control with correction dependent on frequency, reactive power and voltage, as well as all-system and local switching and protecting schemes are discussed.

38616 **Methodology of determination in the estimation of power system automation effects.** Kalinowski, T.; Zelenski, A. *Energetyka;* No. 12, 506-508(1978). (In Polish).

The methodology of economic effects' determination for power systems automation with consideration of social factors is presented. The nature of the effects caused by particular components is discussed.

38617 **Microprocessor oriented data acquisition and control system for power system control.** Mulder, M.C.; Fasang, P.P. (Bonneville Power Administration, Portland, OR). pp 74-78 of 3rd annual symposium on computer architecture. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976).

From 3. annual symposium on computer architecture; Clearwater, FL, USA (19 Jan 1976).

A MICRO processor is described that is oriented Data Acquisition and Control system referred to as MICRODAC which is capable of monitoring high voltage perturbations (via transducers), accepting and issuing control commands, performing format changes and error encoding/decoding, performing system self checks, and transmitting data to supervisory computers. This system performs a very necessary function in power system data acquisition and control at low cost, high reliability, and low power consumptions. 1 reference.

AC SYSTEMS, EHV AND UHV

REFER ALSO TO CITATION(S) 38572

38618 **Fundamental techniques for gas-insulated apparatus.** Murakami, Y.; Menju, S. *Toshiba Rev., Int. Ed.;* No. 117, 5-12(Sep 1978).

Several technical examples of basic research in regard to gas insulation solid insulators and gas seals are described. This is intended to extend further the technical basis, to accumulate study results, to improve the reliability and rationality of gas-insulated apparatus, and to contribute to the development of UHV-AC and HVDC power transmission.

DC SYSTEMS

REFER ALSO TO CITATION(S) 38618

38619 (COO—5014-3) **Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978—December 31, 1978.** Long, W.F. (Wisconsin Univ., Madison (USA)). Jan 1979. Contract ET-78-S-02-5014. 8p. Dep. NTIS, PC A02/MF A01.

Two Priority One activities have received major attention during this reporting period. Application credits for HVDC systems imbedded in ac links are expected to evolve out of a system study wherein dc is introduced into a system where the breakeven criterion is not satisfied. Alternative benefits of the dc link will be quantified in an attempt to develop an expanded economic basis for HVDC systems. HVDC circuit breaker development is being examined, as there appears to be a relationship between the acceptance of multiterminal dc systems and the availability of a dc breaker. At the present time there is a large technical gap between laboratory status and field availability. Further investigation of dc interruption techniques is recommended, together with the establishment of operating criteria and design specifications. A variety of other HVDC activities was undertaken, including proposal review, contract progress report assessment, inverter commutation with series capacitor assistance, and conference planning.

38620 **High voltage dc for resource development.** Spencer, A.G. (Teshmont Consultants, Inc., Winnipeg, Canada). *Can. Electr. Eng. J.;* 4: No. 1, 9-12(Jan 1979).

Natural sources of energy are often remotely located and transportation to the point of utilization becomes a problem. Although energy in the form of fuel for thermal plants may be physically transported, it may be converted to electrical energy at the source, as is usual in the case of hydraulic energy. Electrical energy may be transmitted by conventional alternating current transmission systems, subject to certain limitations. When the distances are great or when water crossings are involved, the limitations of ac systems make dc transmission an attractive alternative.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

38621 (LA—7635-MS) **Energy losses in a flat transposed cable.** Turck, B. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

Extra energy losses caused by the coupling currents between strands in a flat superconducting cable that is exposed to an external changing field are derived. Special attention is given to the cable with an insulating strap interposed between the two layers of strands so as to reduce the losses noticeably. We show that the losses are not reduced as much as we might expect.

38622 (LA—7707-PR) **DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977—September 30, 1978.** Edeskuty, F.J.; Sheheen, N.N. (comps.). (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 154p. Dep. NTIS, PC A08/MF A01.

This annual progress report of the Los Alamos Scientific Laboratory dc Superconducting Power Transmission Line (SPTL) Development Project covers the period October 1977 to September

1978. Progress is described in the electrical engineering, cryogenic engineering, and superconductor design for a 100-kV, 5-GW at 50-kA dc SPTL.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 38510, 38565, 38878

38623 Tekhnologiya reaktorostroeniya. (Technology of reactor construction). Korsakov, V.S.; Bygorvskii, V.F.; Mikhan, V.I. Moscow, USSR; Atomizdat (1977). 272p.

A presentation is made of basic problems in the technology of reactor construction. Brief concepts are given on reactor apparatus, their working conditions and requirements. The greatest amount of attention is given to the technology of manufacturing elements for the active zones of reactors. A discussion is made of problems in the production of billets,mechanical processing, group and general assembly as well as control and testing. Types of technological equipment are cited as well as examples of advanced tooling, processing systems, and assembly. An examination is made of the technological design of various reactor elements, and a comparison is made of alternatives for their production. The book reflects achievements in both domestic and foreign industry and prospects for the development of reactor construction technology. The book is designed for students in design specialties in the field of reactor construction, and can be useful to personnel at design bureaus and industry. 9 references, 212 figures, 14 tables.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 38762, 38773, 38777, 38804, 38806, 38812, 38816, 38817, 38818, 38821, 38822, 38823, 38827, 38829

38624 (COO—4066-9) **Fuel performance improvement program. Quarterly progress report October—December 1978.** Crouthamel, C.E. (comp.). (Exxon Nuclear Co., Inc., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830;EY-76-C-02-4066. 55p. Dep. NTIS, PC A04/MF A01.

The Fuel Performance Improvement Program has as its objective the identification and demonstration of fuel concepts with improved power ramp performance. Improved fuels are being sought to allow reduction or elimination of fuel related operating guidelines on nuclear power plants such that the fuel may be power manuvered within the rates allowed by the system technical specifications. The program contains a combination of out-of-reactor studies, in-reactor experiments and in-reactor demonstrations. Fuel concepts initially being considered include annular pellets, cladding internally coated with graphite and packed-particle fuls. The performance capability of each concept will be compared to a reference fuel of contemporary pellet design by irradiations in the Halden Boiling Water Reactor. Fuel design and process development is being completed and fuel rod fabrication will begin for the Halden test rods and for the first series of in-reactor experiments. The in-reactor demonstrations are being performed in the Big Rock Point reactor to show that the concepts pose no undue risk to commercial operation. Additional concepts may be considered as the result of a state-of-the-technology review of fuel-cladding interaction and assessment of fuel concepts and the out-of-reactor studies. The results of the program will be used to establish the technical bases for design of fuels with improved power ramp performance.

38625 (INIS-mf—4506, pp v) **Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The stress intensity factors (Ksub(I)) for corner cracks in a boiling water reactor feedwater nozzle with stainless steel cladding are obtained for loading by internal pressure, and a fluid quench in the nozzle. Conditions with and without residual stress in the component are considered. The residual stress is simulated by means of a reference temperature change. The stress distribution for the uncracked structure is obtained from a three-dimensional finite element model. A three-dimensional influence function (IF) method, in conjunction with the boundary-integral equation method for structural analysis, is employed to compute Ksub(I) values from the uncracked structure's stress distribution. For each type of loading Ksub(I) values are given for cracks at 15 nozzle locations and for six crack depths. Reasonable agreement is noted between calculated and previously published pressure-induced Ksub(I) values. Comparisons are made to determine the effect on Ksub(I) of crack location, thermal stress, and residual stress as compared to pressure stress. For the thermal transient it is shown that Ksub(I) for small crack depths is maximized early in the transient while Ksub(I) for large cracks is maximized later, under steady state conditions. Ksub(I) computations should, therefore, be made for several transient time points and the maximum Ksub(I) for a given crack depth should be used for design analysis. It is concluded that the effects on Ksub(I) of location, thermal stresses, and residual stresses are significant and generally too complex to evalute without advanced numerical procedures. The utilized combination of finite element analysis of the uncracked structure and three-dimensional influence function analysis of the cracked structure is demonstrated .

38626 (NEDC—24143) **Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution.** Walker, W.L. (General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Sep 1978. 38p. General Electric, San Jose, CA.

Corrosion tests were performed to evaluate the extent of intergranular attack on sensitized Type-304 stainless steel by a proprietary Dow Chemical solvent, NS-1, which is to be used in the chemical cleaning of the Dresden 1 primary system. In addition, tests were performed to evaluate stress corrosion cracking of sensitized Type-304 stainless steel and post-weld heat-treated ASTM A336-F1, A302-B, and A106-B carbon and low alloy steels in a solution to be used to remove residual metallic copper from the Dresden 1 primary system surfaces following the chemical cleaning. No evidence of deleterious corrosion was observed in either set of tests.

38627 (RISO—373) **FFRS: A computer program for the thermal and mechanical analysis of fuel rods.** Misfeldt, I. (Risoe National Lab., Roskilde (Denmark)). Feb 1978. 53p. Dep. NTIS (US Sales Only), PC A04/MF A01.

FFRS, a computer code for simulation on in-pile fuel rod performance, was developed for use in reliability predictions for LWR fuel. As this application involves numerous fuel simulations, the model is sufficiently simple to allow for fast computer calculation, but still detailed enough for realistic simulations. Detailed descriptions for the stationary thermal and mechanical models are given together with the methods of solution for time-dependent irradiation conditions. Models describing the important material properties for zircaloy UO_2, and the gap between fuel and cladding are included in the code.The influence of various parameters in the model has been investigated. The performance of FFRS was examined through the simulation of a large number of irradiation experiments, including sensitivity studies for some of the material properties. It is demonstrated that FFRS can very accurately model average fuel behaviour under operational conditions with very low computer costs.

38628 Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits. Nicholson, F.D.; Evans, J.V. (Australian Atomic Energy Commission Research Establishment, Sutherland). *Corrosion;* 35: No. 4, 158-164(Apr 1979).

Following reports that injections of nickel hydroxide facilitated the removal of crud from the Garigliano Boiling Water Reactor (BWR), nickel hydroxide was injected into a high temperature water loop simulating BWR operation. The injections repeatedly caused large crud bursts in which iron appeared almost exclusively as nickel ferrite. After the crud bursts, iron and nickel redeposited rapidly and preferentially into heated surfaces, although the mobility of ferritic crud in the loop was increased. Filtration and ion exchange of the coolant, accompanied by the continuous injection of nickel hydroxide, removed small quantities of ferritic crud from the system, but not from heated surfaces. Less than 2% of the nickel injected was removed from the loop. The injection of small quantities of nickel during shutdown did not increase the rate of removal of iron by the purification system, although 75% of the nickel injected was eventually removed by the purification system. Given the tendency of nickel to remain in the system and deposit on heated surfaces, it is probable that injection of nickel into the primary coolant of a BWR would lead to increased radiation fields around the plant, even though small quantities of ferritic crud may be removed from the system. The increased mobility of nickel ferrite is worthy of further investigation, but at present the injection of nickel into BWRs cannot be recommended.

38629 On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany. Dio, W.H.; Stoelben, H. (Kraftwerk Union A.G., Erlangen (Germany, F.R.). Hauptbereich Reaktortechnik); Bastl, W.; Wach, D.; Raible, B. pp 747-758 of Reactor noise - SMORN II. Williams, M.M.R. (Queen

Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

In 1967 measurements of the neutron flux noise taken at the Obrigheim nuclear power plant suggested that there may exist a correlation between the noise of the signals from the external neutron flux instrumentation and the movements of the pressure vessel internals. In a comprehensive test program at the Stade nuclear power plant (PWR) the development of surveillance methods and systems for the early detection of failures was intensified. In particular the analysis of the data measured during power operation could be based on measurements of the natural frequencies of the internals and on the results of the functional tests. For the first time at Stade the 'double pendulum model' for the movement of the reactor pressure vessel and core barrel was developed. Work was begun on the interpretation of the measurements by means of wide-ranging theoretical investigations, multi-mass model development and so on. In addition to vibration and neutron noise measurements at Stade also measurements of structure-borne sound were performed referring to loose parts detection. Work in this field was continued on the reactors of the Biblis series, GKN and the boiling-water reactors. This paper deals with the noise analysis related to monitoring systems. It does not go into the BWR problems related to boiling (void) or lance motion.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 38624, 38627, 38629, 38762, 38763, 38777, 38794, 38796, 38797, 38802, 38805, 38806, 38812, 38813, 38814, 38815, 38816, 38817, 38818, 38822, 38823, 38825, 38827

38630 (AED-Conf—78-155-006) **U-type steam generators for nuclear power plants and their manufacture.** Shopf, A. (Balcke-Duerr A.G., Bochum (Germany, F.R.)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 7p. (In German). (CONF-7804102—32). Available from ZAED.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

In nuclear power plants with pressurized water reactors, steam generators are the connecting link between the primary and secondary circuits. Their duty is to pass the thermal energy transferred by the reactor to the primary circuit on to the secondary circuit with as little losses as possible. Further the steam generators have got the task of safety separating the radioactive water circulating in the primary circuit from the steam circulating in the conventional secondary circuit. This double function as well as the necessity of housing the apparatuses within the containment determine construction and design of the steam generators.

38631 (CONF-790313—4) **Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment.** Bamford, W.H.; Moon, D.M. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.). 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

From NACE/Corrosion 1979 meeting; Atlanta, GA, USA (12 Mar 1979).

The fatigue crack growth behavior of A533B and A508 pressure vessel steel and AISI Types 304 and 316 steels used in reactor coolant piping have been studied in a pressurized water reactor environment at 288°C (550°F). The influence of stress ratio (P/sub min//P/sub max/), frequency, ramp times, specimen orientation and material microstructures were included in the study. While none of the materials showed evidence of static crack growth in the environment, the ferritic steels did show an enhanced fatigue crack growth rate at test frequencies of five cycles per minute and lower. Based on fractographic examinations the enhanced growth rate is not the result of environmentally induced intergranular or cleavage modes of crack propagation. Instead, striation spacing measurements were found to agree with the macroscopic crack growth rate, demonstrating a time dependent environmental interaction which introduces a frequency dependent enhancement of the mechanically developed striations. Crack growth experiments using hold times have confirmed the absence of any superimposed contribution of static crack growth components. Fatigue crack growth tests were conducted in an environment of Hydrogen Sulfide gas to establish the contribution of hydrogen embrittlement and will also be described.

38632 (INIS-mf—4506, pp v) **Finite element analysis of crack propagation problems for the fracture mechanics evaluation of reactor vessel nozzle junction.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

38633 (NUREG/CR—0755) **Gamma dose measurements at Zion and Fort Calhoun Stations.** Dyer, N.C.; Bunting, R.L.; Nieschmidt, E.B.; Croney, S.T.; Kynaston, R.L.; McIssac, C.V.; Underwood, D.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. 145p. NTIS, PC A07/MF A01.

The objective of this study was to provide experimental data to the NRC for evaluation of the gamma radiation fields in personnel access areas within operating LWR's. As partial fulfillment of this objective, data were obtained at two PWR's on in-plant gamma radiation fields in areas such as inside and outside equipment cubicles and spent fuel pool areas. Also, airborne radionuclide concentrations were measured in areas where plant personnel could be working during a refueling outage. Data presented were obtained at the Zion Station operated by Commonwealth Edison Co. and located near Zion, Illinois, and at the Fort Calhoun Station - Unit 1 operated by the Omaha Public Power District and located near Blair, Nebraska.

38634 (UCID—17958) **Review of tube support plate analysis for steam generators of Millstone Unit II Nuclear Power Plant.** Ma, S.M.; Lu, S.C.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1978. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

Magnetite growth in steam generator tube support plates was observed in the Millstone Unit II Nuclear Power Plant. If growth is allowed to continue, the tube may eventually fail resulting from plate shifting and the squeezing action of the growing magnetite. The corrective actions undertaken by the Northeast Nuclear Energy Company (NNECO) for this effect have been summarized in a report submitted to the U.S. Nuclear Regulatory Commission (NRC) entitled, Millstone Unit No. II Steam Generator Repairs and Corrective Actions, Docket No. 50-336. The analytical study part of this report is reviewed here, and conclusions and recommendations for further research are given.

38635 **Neutron noise measurements on pressurized water reactors.** Bernard, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Div. d'Etudes et de Developpement des Reacteurs); Brillon, A.; Carre, J.C.; Sighicelli, S. pp 333-351 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Noise analysis contributes to increase significantly understanding of safety and monitoring of PWR. The difficulties of a correct interpretation of noise signal in a power reactor encourage a deeper insight into the theoretical model. This paper deals with 4 topics: (a) theoretical model; (b) measurements made in PWRs and evolution of power spectral densities; (c) experimental test of models; and (d) future study of this range: methodology for early detection of failure and to indicate incipient failure. Using the expressions for linear system and for feedback loop, we obtain a simplified diagram for PWR with reactivity, temperature, velocity of fluid inputs and movement of internal structures. Neutron noise measurements are performed periodically on the 'Centrale Nucleaire des Ardennes'. An investigation is also performed, in order to detect core barrel movements. The change of neutron noise at several power levels is shown, and used to check the model. The development of signal analysis and models for PWR is investigated in the last chapter.

38636 **Experience with diagnostic instrumentation in nuclear power plants.** Gopal, R.; Ciaramitaro, W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). pp 759-779 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Over the past several years, Westinghouse has developed a coordinated system of on-line diagnostic instrumentation for the acquisition and analysis of data for diagnostics and incipient failure detection of critical plant equipment and systems. Primary motivation for this work is to improve NSSS availability and Maintainability through the detection of malfunctions at their inception. These systems encompass the following areas: (1) Vibration Monitoring System for detection of changes in vibrational characteristics of the major components of Nuclear Steam Supply System (NSSS) and Balance of Plant (BOP); (2) Acoustic Monitoring System for detection and location of leaks in the primary system pressure boundary

and other piping systems in PWRs; (3) Metal Impact Monitoring for detection of loose debris in the reactor vessel and steam generators; (4) Nuclear Noise Monitoring System for monitoring core barrel vibration; (5) Sensor Response Time Measurement System for detecting any degradation of process sensors; and (6) Transit Time Flow Meter for determining primary coolant flow rate. Summarized in this paper are some of the features of the systems and in-plant experience. These experiences demonstrate that diagnostic systems in combination with analytical and laboratory work for data interpretation do improve plant availability.

38637 Decomposition of noise signals composed of many similar components. Grabner, A.; Liewers, P.; Schumann, P.; Weiss, F.P. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). pp 615-628 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The interpretation of noise signals which are composed of many similar components from different noise sources is extremely difficult. By means of an experimental example the possibility of decomposition in the frequency and time domain is demonstrated in this paper.

38638 Some recent developments in reactor noise analysis at Swierk. Mikulski, A.T. (Institute of Nuclear Research, Warsaw (Poland)). pp 701-706 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The present interest in noise analysis in Poland is in the systematic collection of noise signatures of a research reactor, and analysis of available noise data from power reactors of the VVER-440 type. The details are discussed under the headings: measuring system; EWA reactor noise; VVER-440 reactor noise. Under each heading there was considered: RMS-value; probability distribution function; polarity correlation function; power spectral density.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 38715, 38716, 38719, 38789, 38799, 38809, 38812

38639 (GA-A—15159) **Fort St. Vrain Surveillance Program: Transient Analysis Program (TAP) verification.** Love, C.C.; Potter, R.C. (General Atomic Co., San Diego, CA (USA)). Feb 1979. Contract EY-76-C-03-0167-065. 142p. Dep. NTIS, PC A07/MF A01.

As part of the Fort St. Vrain Plant Surveillance and Testing task under the HTGR Generic Technology Program, plant performance data acquired during the startup testing have been used to perform a verification of the overall plant transient analysis program (the TAP code). During FY 1978, the plant operated over a thermal power range from 30% to 70%. Data were acquired for several steady state operating points in this power range and TAP vs. plant comparisons were made for these cases. In addition, transient performance comparisons were made for several different measured plant transients.

38640 (INIS-mf—4426, pp IV.1-16) **Qualification of HTGR fuel by rig development and irradiation testing at BR2 Mol.** Pott, G; Juenemeann, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)); Mehner, A.W. (Nucletron, Gesellschaft fuer Nucleonic und Electronic m.b.H., Muenchen (Germany, F.R.). Entwicklungslaboratorium); Moons, F. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

The document presents the irradiation testing of fuel and the development of the devices for the experiments on high and medium enriched uranium and thorium fuel coated particles. The aims of the different types of irradiation experiments are presented and the results of experiments are presented. The irradiation devices, especially in pile sections and out-of-pile equipment are presented. Near term applications for the fuel coated particles development are given.

38641 (LA—7709-T) **Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores.** Stroh, K.R. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 182p. Dep. NTIS, PC A09/MF A01.

Thesis.

The pebble bed reactor's cylindrical core volume contains a random bed of small, spherical fuel-moderator elements. These graphite spheres, containing a central region of dispersed coated-particle fissile and fertile material, are cooled by high pressure helium flowing through the connected interstitial voids. A mathematical model and numerical solution technique have been developed which allow calculation of macroscopic values of thermal-hydraulic variables in an axisymmetric pebble bed nuclear reactor core. The computer program PEBBLE is based on a mathematical model which treats the bed macroscopically as a generating, conducting porous medium. The steady-state model uses a nonlinear Forchheimer-type relation between the coolant pressure gradient and mass flux, with newly derived coefficients for the linear and quadratic resistance terms. The remaining equations in the model make use of mass continuity, and thermal energy balances for the solid and fluid phases.

38642 (ORNL/TM—6478) **Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems.** Naus, D.J. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 192p. Dep. NTIS, PC A09/MF A01.

Nongrouted tendons are predominantly used in this country as the prestressing system for prestressed concrete pressure vessels (PCPVs) because they are more easily surveyed to detect reductions in prestressing level and distress such as results from corrosion. Grouted tendon systems, however, offer advantages which may make them cost-effective for PCPV applications. Literature was reviewed to (1) provide insight on the behavior of grouted tendon system, (2) establish performance histories for structures utilizing grouted tendons, (3) examine corrosion protection procedures for prestressing tendons, (4) identify arguments for and against using grouted tendons, and (5) aid in the development of the experimental investigation. The experimental investigation was divided into four phases: (1) grouted-nongrouted tendon behavior, (2) evaluation of selected new material systems, (3) bench-scale corrosion studies, and (4) preliminary evaluation of acoustic emission techniques for monitoring grouted tendons in PCPVs. The groutability of large tendon systems was also investigated.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 38751

38643 Chemistry of the PSGHWR heavy water moderator system. Chance, L.A. (UKAEA, Winfrith. Atomic Energy Establishment). pp 479-488 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The PSGHWR heavy water moderator and helium overblanket circuits, and the heavy water purification plant are described. Details of the deuterisation and dedeuterisation of ion exchange resin charges for the purification plant are given, and a pattern of consistency over seventeen deuterisations of anion and cation beds is shown. The chemistry specification for the moderator system is given, and the changing philosophy of ion exchange plant operation to maintain this specification, from early operation with continuous flow through cation and anion clean up columns, to the current mode of minimum intermittent flow, is explained. Anionic and cationic impurities and radio nuclides found in the moderator are listed, and their sources examined. The inter-relation between the ion exchange plant as a source as well as a remover of impurities and the part played by peroxide is examined.

38644 Release of radioiodines from defective fuel in WSGHWR. Comley, G.C.W. (UKAEA, Winfrith. Atomic Energy Establishment). pp 499-510 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The release rates of radioiodines into the boiling water coolant of WSGHWR from occasional fuel pin defects is considered. The data presented includes radio iodine concentrations and iodine balances around the system, the effects of system depressurisation and power cycles. The relationship between release rates of radio iodines and their decay constant is reviewed.

38645 Examination of radioactive particles in WSGHWR coolant circuits using scanning electron microscope autoradiography. Darley, P.J.; Macfarlane, B.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 257-263 of Water chemistry

of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Scanning Electron Microscope Autoradiography (SEMA) has been used, in conjunction with Energy Dispersive X-ray Spectroscopy (XES) to simultaneously determine the radiological, physical and chemical characteristics of corrosion product particles from the coolant circuit of WSGHWR. This paper contains an outline of the recently developed SEMA technique and presents the preliminary results of analyses of particulate samples from the circulating coolant and both in and out of core surfaces. Insights into the mechanisms of ^{60}Co activity transport provided by the observed variation in the properties of the individual particles making up the crud in the different regions of the circuit are discussed and a tentative mechanistic model is suggested.

38646 Development of the CANDU heat transport purification system design philosophy. Drolet, T.S.; Heathcock, R.E.; Lauchlan, I.E.B. (Ontario Hydro, Toronto (Canada)). pp 315-319 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Ontario Hydro, a Canadian utility using pressurized heavy water reactors for a portion of its generating capacity has changed its purification system design philosophy over the last 16 years from a system concept solely designed to keep water chemistry purity specifications in limits to systems which also enable operations staff to minimize: a) the transport of soluble and insoluble corrosion and fission products, b) permit periodic chemical decontamination clean-up with in-reactor equipment and c) trap activity during system upset conditions.

38647 Chemical control and design considerations for CANDU-PHW steam generators. Frost, C.R.; Churchill, B.R. (Ontario Hydro, Toronto (Canada)). pp 37-42 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Ontario Hydro presently operates eight nuclear power units with a total capacitiy of about 4000 MW(e) net. Operating experience has been with Monel-400 and with Inconel-600 tubed steam generators using sodium phosphate or all volatile control of the boiler steam and water system. With a heavy water Heat Transport System, steam generator tube integrity is an essential ingredient of economical power production. Only three steam generator tube failures have occurred so far in about 40 unit-years operation. None was attributable to corrosion. Factors in the good reliability are, careful engineering design, good quality control at all stages of tubing and steam generator manufacture and close chemical control. The continuing evolution of our steam generator design means that future requirements will be more stringent.

38648 Graphite beds for coolant filtration at high temperature. Heathcock, R.E.; Lacy, C.S. (Ontario Hydro, Toronto (Canada)). pp 321-327 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

High temperature filtration will be provided for new Ontario Hydro CANDU heat transport systems. Filtration has been shown to effectively reduce the concentration of circulating corrosion products in heat transport systems, hence, minimizing the processes of activity transport. One option for this application is described: Deep Bed Granular Graphite Filters. The filter system is described by discussing pertinent aspects of its development programme. The compatibility of the filter and the heat transport coolant are demonstrated by results from loop tests, both out- and in-reactor, and by subsequent results from a large filter installation in the NPD NGS heat transport system.

38649 Release of alloying constituents of stainless steel in SGHWR calandria environment. Jarvis, G.J. (Nuclear Power Co. (Whetstone) Ltd. (UK)). pp 89-96 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The release of chromium and cobalt from stainless steel in simulated SGHWR moderator environment follows a logarithmic rate law, the ratio of the two release rates is the same as that of the metals in the parent alloy.

38650 Decontamination experience at CANDU-PHW reactors. Lacy, C.S.; Stewart, W.B.; Mitchell, A.B. (Ontario Hydro, Toronto (Canada)). pp 385-391 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Several years experience in operating and maintaining nuclear-electric generating stations has demonstrated the usefulness of chemical and mechanical decontaminations. Examples of techniques developed for the CANDU-PHW reactors are described in the belief that Ontario Hydro experience may be of use to other utilities. These examples include the decontamination of the external surfaces of a fuelling machine, the decontamination of internal surfaces of a fuelling machine and of pumps, and the CAN-DECON decontamination of the whole heat transport system of Douglas Point NGS.

38651 Water chemistry of CANDU PHW reactors. LeSurf, J.E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 177-186 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

This review will discuss the chemistry of the three major water circuits in a CANDU-PHW reactor, viz., the Primary Heat Transport (PHT) water, the moderator and the boiler water. An important consideration for the PHT chemistry is the control of corrosion and of the transport of corrosion products to minimize the growth of radiation fields. In new reactors the PHT will be allowed to boil, requiring reconsideration of the methods used to radiolytic oxygen and elevate the pH. Separation of the moderator from the PHT in the pressure-tubed CANDU design permits better optimization of the chemistry of each system, avoiding the compromises necessary when the same water serves both functions. Major objectives in moderator chemistry are to control (a) the radiolytic decomposition of D_2O; (b) the concentration of soluble neutron poisons added to adjust reactivity; and (c) the chemistry of shutdown systems. The boiler water and its feed water are treated to avoid boiler tube corrosion, both during normal operation and when perturbations are caused to the feed by, for example, leaks in the condenser tubes which permit ingress of untreated condenser cooling water. Development of a system for automatic analysis and control of feed water to give rapid, reliable response to abnormal conditions is a novel feature which has been developed for incorporation in future CANDU-PHW reactors.

38652 Growth of radiation fields around CANDU boilers. Lister, D.H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 207-214 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The mechanisms by which nuclear boiler tubes are contaminated by radioactive corrosion products have been investigated in the laboratory and described by mathematical models. When the models are applied to full-size CANDU boilers they show that, as expected, the contamination of the tubes increases with increasing heat flux while the total inventory of radioactivity increases with increasing size. Radiation fields outside the shell, however, are influenced more by the shielding provided by the internal components and the water, and are actually predicted to be smaller for the larger units. When the effects of varying the primary circuit materials are included in the models, boiler radiation fields from radioactive corrosion products in future CANDU stations are predicted to be very low indeed.

38653 High flow, high temperature magnetic filtration of the primary heat transport coolant of the CANDU power reactors. Moskal, E.J. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). pp 329-339 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

An equation was developed to describe the relationship of the separation efficiency of a magnetic filter to a group of system parameters. Preliminary tests on a low temperature test bed indicated that the equation satisfactorily described the performance of the magnetic filter. Magnetic filtration tests on high temperature loops indicated that the circulating corrosion product concentrations were reduced. On a nuclear power reactor, the specific activity of the corrosion products was reduced, and filtration of the coolant may have contributed to the reduction in the general boiler room fields.

38654 Decontamination of the SGHWR prototype. Nash, G.J.C. (UKAEA, Winfrith. Atomic Energy Establishment). pp 377-383 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

A regime for regular decontaminations of a 100 MW(e) prototype power reactor has been evolved. The process, the plant

and the operations are outlined. Results are presented and modifications to improve the process are discussed. Methods for disposing of the wastes are described.

38655 Radioactivity buildup in Pickering nuclear generating station heat transport system. Neil, B.C.J. (Ontario Hydro, Pickering (Canada). Pickering Generating Station). pp 235-238 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The buildup of radioactivity in any reactor system is a function of its purpose, the materials of construction, system chemistry control and purification regime. Each reactor and reactor system has its own characteristics. For Pickering NGS, the largest fully operational CANDU-PHW station in Ontario, a program to establish the mechanism of radioactivity buildup has been in progress for several years. The program and the results obtained so far are reported. Special techniques including portable gamma-ray spectroscopy, radiation field monitoring, and the radio-chemical analysis of samples of particulate crud, fuel deposits and oxidized system material surfaces are described.

38656 Some aspects of water chemistry in the CSGHWR. Riley, J.A. (Nuclear Power Co. (Risley) Ltd. (UK)). pp 519-527 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The water chemistry of several of the major light and heavy water systems of the CSGHWR is described with reference to the situations on the Winfrith SGHWR on which the design of CSGHWR is based.

38657 Formation, composition and structure of corrosion products in CANDU nuclear power reactors. Rummery, T.E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). pp 239-248 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

To gain a better understanding of the formation and transport of corrosion products in CANDU-PHW power reactors, and the role played by these products in the generation and subsequent fixation of radioactive species, we have examined in detail several surfaces removed from the Douglas Point Generating Station (Douglas Point, Ontario). Results are given for the surface of the primary-side of a Monel-400 boiler tube, and surfaces of carbon steel piping at the inlet and outlet of the boiler. The experimental techniques that were used included sequential acid stripping, X-ray diffractometry, scanning electron microscopy and energy dispersive X-ray spectrometry.

38658 Outline of the water systems chemistry requirements for a large commercial SGHWR. Streatfield, R.E. (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.). pp 511-518 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The main features of the proposed feedwater/coolant plant for a commercial SGHWR are described with particular reference to circuit chemistry and materials choice. The adopted techniques for decontamination and the control of off-load chemistry are also discussed together with certain plant options to minimise circuit activity levels. The main functions of the heavy water control and purification plant are discussed in the context of the commercial operation of a large power reactor.

38659 Optimization of decontamination strategy for CANDU-PHW reactors. Walton, F.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). pp 393-400 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Theoretical models of the decontamination process are developed and combined with an existing model of ^{60}Co production in CANDU PHW reactors to predict the effects of decontamination on long term ^{60}Co build-up in reactor primary heat transport systems. The effects of decontamination interval, decontamination factor, and post-decontamination corrosion release are calculated. An optimum decontamination strategy for a Pickering G.S. type reactor is developed on the basis of a cost-benefit analysis. This study indicates that the optimum decontamination interval is approximately six years. This optimum interval is relatively insensitive to variations in the costs of personnel exposure, the cost of a decontamination, the decontamination factor, and the post-decontamination corrosion model used.

38660 Options for radiation field reduction: their potential and benefit to cost ratio. Walton, F.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). pp 401-406 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

Reduction of radiation fields associated with activated corrosion products in the out-core primary heat transport (PHT) system of CANDU PHW reactors has been achieved by: More stringent specifications of PHT coolant chemistry to minimize corrosion product generation and in-core fuel deposits; higher coolant purification rates to remove both active and inactive corrosion products; selection and specification of PHT materials of construction to reduce the source of potential radio-nuclides; decontamination of the PHT system. Additional reductions, resulting from further adjustment of coolant chemistry to reduce in-core deposits and to decrease corrosion product release from PHT components, have been forecast. The purpose of this paper is to compare the current and proposed methods with respect to their estimated long-term potential for radiation field reduction and their relative benefit to cost ratios.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 38790, 38791, 38798, 38800, 38803, 38812, 39167

38661 (ANL—78-99) **Results of UO_2 diagnostic tests for run beyond cladding breach in EBR-II.** Strain, R.V.; Lambert, J.D.B. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 36p. AT.

Predefected UO_2 fuel elements were irradiated in EBR-II to determine the response of the fission-product-monitoring systems. In particular, the tests were performed to indicated whether the amount of oxide fuel exposed to the primary sodium could be estimated by monitoring, with the fuel-element-rupture detector (FERD), delayed neutrons (DN's) emitted from bromine and iodine isotopes in the sodium. Elements with defect areas of 0.005 and 0.20 cm^2 were irradiated consecutively in April and June 1977. The smaller defect produced no measurable DN signal, and the larger defect produced a DN signal of ~ 55 counts per second (cps) while irradiated at 11.3 kW/ft (3.44 kW/m) and 70 cps at 14.3 kW/ft (4.35 kW/m). The signal of 55 cps was about 20 times the signal that would be expected if the release from the defect had been solely by recoil from the exposed fuel. Postirradiation examination of the elements showed that an unexpectedly large amount of UO_2/sodium chemical reaction occurred in the element with the 0.20-cm^2 defect.

38662 (ANL-CT—79-16) **Review on fluid forces on circular cylinders in cross flow.** Nahavandi, A.N.; Chen, S.S. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 68p. AT.

The objective of the study is to recommend the most promising numerical digital-computer-oriented methods for the computation of fluid forces on a single rigid cylinder or an array of rigid cylinders. The scope of the work specifically includes: (1) performing an extensive literature search on the analytical, numerical and other solution techniques applicable to this problem; (2) comparing the advantages and disadvantages of the available solution techniques; and (3) recommending the most promising numerical techiques and computer codes for the computation of hydrodynamic loading on cylinders in cross flow.

38663 (COO—2245-65) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1978—August 31, 1978.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1978. Contract EY-76-S-02-2245. 29p. Dep. NTIS, PC A03/MF A01.

Information is presented concerning coolant mixing in LMFBR fuel rods in wrapped and bare bundle geometry; LMFBR outlet plenum flow mixing; and theoretical determination of local temperature fields in LMFBR fuel rod bundles.

38664 (COO—2245-66) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1978—November 30, 1978.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1978. Contract EY-76-S-02-2245. 31p. Dep. NTIS, PC A02/MF A01.

Information is presented concerning coolant mixing in LMFBR fuel rods in wrapped and bare bundle geometry; LMFBR outlet plenum flow mixing; and theoretical determination of local temperature fields in LMFBR fuel rod bundles.

38665 (COO—2250-35) **MIT LMFBR blanket research project. Quarterly progress report, October 1—December 31, 1978.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 15 Feb 1979. Contract EY-76-S-02-2250. 29p. Dep. NTIS, PC A03/MF A01.

Progress in the development of LMFBR and GCFR breeding blanket design parameters is reported under the following headings: interface self-shielding and advanced blanket investigations.

38666 (GEFR—00414) **Baseline inspection of three transition joint life test articles.** Day, R.A. (General Electric Co., Sunnyvale, CA (USA)). Dec 1978. Contract EY-76-C-03-0893-030. 48p. AT.

Ultrasonic inspection was accomplished on the Transition Joint Life Test (TJLT) articles using a semiautomatic computer controlled pipe scanner. Tests were capable of reliable detection of ten and five percent notch in the Alloy 800 and 316 stainless steel parent materials and at least a three percent notch in the 2-1/4Cr—1Mo parent metal. The detection of notches in the weld metal has not been established, but ten percent notches were detectable above weld metal noise in the 316 parent metal by insonifying the 16-8-2 weld metal from the Alloy 800 parent metal. The TJLT joints will be reinspected at intervals at the Energy Technology Engineering Center (ETEC) in Los Angeles to detect creep fatigue cracks in the 2-1/4Cr—1Mo HAZ. The same equipment will be used with some improvements to do the in-service inspections.

38667 (GEFR-SP—151) **Welding for the CRBRP steam generators.** Spalaris, C.N.; Ring, P.J.; Durand, R.E.; Wright, E.A. (General Electric Co., Sunnyvale, CA (USA); Atomics International Div., Canoga Park, CA (USA); Clinch River Breeder Reactor Plant Project Office, Oak Ridge, TN (USA)). 1979. Contract EW-76-C-15-2395;EW-76-C-15-0003. 9p. (CONF-790426—2). Dep. NTIS, PC A02/MF A01.

From International conference on welding and fabrication in the nuclear industry; London, UK (2 Apr 1979).

The rationale for selecting weld design, welding procedures and inspection methods was based upon the desire to obtain the highest reliability welds for the CRBRP steam generators. To assure the highest weld reliability, heavy emphasis was placed on the control of material cleanliness and composition substantially exceeding the requirements of the ASME Code for 2-1/4Cr—1Mo. The high tube/tubesheet weld quality was achieved through close material control, an extensive weld development program and the selection of high reliability welding equipment. Shell and nozzle weld fabrication using TIG, MIG, and submerged arc procedures are also being controlled through precise specifications, including preheat and postheat programs, together with radiography and ultrasonic inspection to ascertain the weld quality desired. Details of the tube/tubesheet welding and shell welding are described and results from the weld testing program are discussed.

38668 (HEDL-SA—1329) **Reactor physics parameters of alternate fueled FBR core designs.** Haffner, D.R.; Hardie, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1977. Contract EY-76-C-14-2170. 31p. (CONF-771109—112). Dep. NTIS, PC A03/MF A01.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

Nuclear non-proliferation considerations have resulted in renewed interest in the thorium fuel cycle. Reactor physics parameters of a typical 1200-MW(e) Fast Breeder Reactor (FBR) design were compared when U-233 is substituted for Pu as a fissile fuel and when Th-232 is substituted for U-238 as a fertile fuel. When the U-238 in the blanket is replace with Th-232, the reactor physics parameters are relatively unchanged. However, replacing U-238 in the core with TH-232 increases the critical mass by 11 to 15% and decreases the breeding ratio by 0.13 to 0.16. In addition, replacing the Pu in the core with U-233 decreases the critical mass by 4 to 6% and decreases the breeding ratio by 0.13 to 0.16. Both of the changes in the core make the sodium void coefficient more negative.

38669 (HEDL-SA—1535-FP) **HEDL mixed oxide fuel pin breach experience in EBR-II.** Weber, J.W.; Almassy, M.Y.; Karnesky, R.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1978. Contract EY-76-C-14-2170. 14p. (CONF-790306—12). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Mixed plutonium—uranium oxide fuel pins clad with stainless steel are being irradiated to cladding breach in the EBR-II for the Hanford Engineering Development Laboratory's (HEDL) Run-to-Cladding-Breach (RTCB) program. The objectives of these tests are to: (1) establish the burnup capability of mixed oxide fuel pins, (2) identify and characterize cladding breach mechanisms, (3) determine the effects of cladding breach on neighboring fuel pins and (4) provide data for developing fuel pin failure criteria. Breaches have occurred in 16 HEDL fuel pins in the RTCB program. Examination and characterization has been completed on 13, with the remaining three in some phase of detailed examination. Characterization, includes identification and classification of the probable cause of each breach. The breaches evaluated have been classified as being due to: local cladding overtemperature, subassembly coolant overtemperature, and cladding and wire wrap wear. The cause for one breach has not been conclusively established. The paper reviews characteristics and discusses the probable mechanisms and causes.

38670 (HEDL-SA—1536-FP) **Mixed oxide run-beyond-cladding-breach tests in EBR-II.** Washburn, D.F.; Almassy, M.Y.; Langstaff, D.C.; Lambert, J.D.B.; Strain, R.V. (Hanford Engineering Development Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA); Argonne National Lab., IL (USA)). 26 Sep 1978. Contract EY-C-14-2170. 14p. (CONF-790306—9). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Fuel pin and subassembly design and quality control during fabrication are intended to ensure that fuel pins can reach goal exposure without cladding breach. However, premature random cladding breaches cannot be precluded. Economic commercial operation of sodium-cooled Fast Breeder Reactors may require operation with breached fuel pins in the core. The alternative to this mode of operation is to remove subassemblies with breached fuel pins at the first indication of cladding breach which is both time consuming and costly. An objective of the U.S. Run-Beyond-Cladding-Breach (RBCB) program is to understand the behavior of mixed oxide fuel during continued irradiation in the post-breach condition. The paper presents the results from the initial RBCB tests of mixed-oxide fuels which were conducted in the Experimental Breeder Reactor-II (EBR-II). Tests conducted to calibrate the EBR-II fission product monitors are also briefly described.

38671 (HEDL-SA—1543-FP) **Cesium migration in LMFBR fuel pins.** Karnesky, R.A.; Jost, J.W.; Stone, I.Z. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1978. Contract EY-76-C-14-2170. 11p. (CONF-790306—10). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The factors affecting the axial migration of cesium in mixed oxide fuel pins and the effects of cesium migration on fuel pin performance are examined. The development and application of a correlated model which will predict the occurrence of cesium migration in a mixed oxide (75 w/o UO_2 + 25 w/o PuO_2) fuel pins over a wide range of fabrication and irradiation conditions are described.

38672 (HEDL-SA—1683-FP) **Steady state irradiation behavior of mixed oxide fuel pins irradiated in EBR-II.** Leggett, R.D.; Heck, E.N.; Levine, P.J.; Hilbert, R.F. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1978. Contract EY-76-C-14-2170. 24p. (CONF-790306—11). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

Results are presented from the steady state fuel irradiation program in EBR-II, which is intended to provide the technology and engineering test data in near-term support of the design and operation of the Fast Flux Test Facility (FFTF) and Fast Breeder Reactors (FBR's) utilizing the reference fuel system - UO_2—PuO_2 mixed oxide with 25 +- 5 w/o PuO_2 and 20% CW Type 316 stainless steel cladding. This program is also intended to develop the base for longer term innovative improvements and design changes required for FBR's and develop design criteria and associated computer-based design codes for accurately predicting fuel performance.

38673 (HEDL-TME—78-93) **Sodium technology progress report, October—December 1978.** Atwood, J.M. (comp.). (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1979. Contract EY-76-C-14-2170. 67p. AT.

This report presents a quarterly summary of progress made at Westinghouse Hanford Company in the areas of radioactivity control technology and sodium systems technology.

38674 (INIS-mf—4426, pp VIII.1-15) **Chemical interaction at the FBR cladding fuel interfaces.** Delbrassine, A.; Retels, J.; Dirven, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

Pins containing UO_2-30 wt.%PuO_2 and/or cesium and/or tellurium as doping elements have been irradiated for about 40 days in the BR2 reactor. The effects of two Cs/Te ratios, namely 1.3 and 4 and a wide range of O/M ratios on the inner corrosion of the clad have been investigated. The influence of Tellurium on the attack of the cladding has been pointed out. It may be responsible for the Chromium NS Nickel depletion in the grain boundaries of the steel. It is necessary to measure the effective Ts/Te ratio associated with the local corrosion layers. This local Cs/Te ratio should be more

useful than the initial mean Cs/Te ratio in a pin for understanding the corrosion phenomene.

38675 (INIS-mf—4426, pp VII.1-20) **Short terms experiments in BR2 towards a better fast fuel performance analysis.** van Vliet, J.; Pay, A. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

The FARFADET experimental program to be performed in the BR2 reactor is aimed to study the begin-of-life fuel temperature with short experiments on well characterized fuel pins for LMFBR type reactors. The article reviews some aspects of the fuel physical restructurig and its chemical effects at begin-of-life, like porosity redistribution, in-pile sintering, fission gas bubble swelling, grain growth, oxygen and actinide redistribution. The planned experiments in the BR2 reactor are presented.

38676 (INIS-mf—4426, pp I.1-13) **Possibilities of application of experimental Kfk results from BR2 on SNR designs.** Karsten, G.; Elbel, K.; Dienst, W.; Schaefer, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

A review is given of the relevant results of the technological application for the SNR300 reactor, since the BR2 reactor has been used as a test facility for the material development. Special emphasis has been laid on the fuel pin behavior under the aspect of chemical and mechanical fuel-clad interaction and on the specification of the cladding in terms of high temperature mechanical behavior in the SNR 300 reactor. A systematic analysis of urgent research topics in BR2 test facility reactor is presented.

38677 (INIS-mf—4426, pp III.1-10) **GSB fuel element review meeting.** Krug, W.; Euringer, H.; Stechemesser, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)); Vanmassenhove, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Jung, W. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

The irradiation program, as a common effort between KFA Julich, KWU-Erlangen and CEN-Mol, of GCFR-fuel rod bundles in the BR2 reactor is described as well as the He-loop-Mol test facility. The main aim of the running irradiation program is to prove the feasibility and the applicability of the GCFR-fuel element concept. Three cycles of test programs with different fuel elements are presented.

38678 (IWGFR—24-3) **International Working Group on Fast Reactors eleventh annual meeting. Summary report, Part III.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). Sep 1978. 30p. (CONF-780487—P3(Summ.)). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 11. meeting on fast reactors; Bologna, Italy (17 Apr 1978).

The Eleventh Annual Meeting of the IAEA International Working Group on Fast Reactors was held at the Palazzo dei Congressi, Bologna, Italy from 17—20 April 1978. The Summary Report (Part I) contains the Minutes of the Meeting. The Summary Report (Part II) contains the papers which review the national program in the field of LMFBRs and other presentations at the Meeting. The Summary Report (Part III) contains the discussions on the review of the national programs.

38679 (KFK—2584) **Theoretical and experimental investigation of the nonlinear structural dynamics of Fast Breeder Reactor fuel elements.** Liebe, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (TH) (Germany, F.R.). Fakultaet fuer Maschinenbau). Apr 1978. 146p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

Thesis.

This study describes theoretical and experimental investigations of the dynamic deformation behavior of single and clustered fuel elements under local fault conditions in a Fast Breeder Reactor core. In particular an energetic molten-fuel-coolant-interaction (FCI) is assumed in one subassembly with corresponding pressure pulses, which may rupture the wrapper and load the adjacent fuel elements impulsively. Associated coherent structural deformation may exceed tolerable and damage the control rods. To attack the outlined coupled fluid-structure-interaction problem it is assumed, that the loading at the structures is known in space and time, and that there is no feedback from the deformation response. Then current FCI-knowledge and experience from underwater core model explosion tests is utilized to estimate upper limits of relevant pulse characteristics. As a first step the static carrying capacity of the rigid-plastic hexagonal wrapper tube is calculated using the methods of limit analysis. Then for a general dynamic simulation of the complete elastoplastic subassembly response the concept of a discrete nonlinear hinge is introduced. A corresponding physical lumped parameter hinge model is presented, and general equations of motion are derived using D'Alembert's principle. Application to the static and dynamic analysis of a single complete fuel element includes the semiempirical modelling of the fuel-pin bundle by a homogeneous compressible medium. Most important conclusions are concerning the capability of the theoretical models, the failure modes and threshold load levels of single as well as clustered SNR-300 fuel elements and the safety relevant finding, that only limited deformations are found in the first row around the incident element. This shows in agreement with explosion test results that the structured and closely spaced fuel elements constitute an effective, inherent barrier against extreme dynamic loadings.

38680 (KFK—2619) **Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation.** Mitzel, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1978. 45p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

In order to improve the safety, the surveillance and economy of sodium cooled reactors it is desirable to obtain a more precise knowledge of the heat transfer between the fuel and the coolant. Different possibilities have been investigated to determine the corresponding heat transfer coefficient by measuring the pertinent transfer functions. The result was the following: The heat transfer coefficient can be determined with reasonable accuracy at the KNK II and the SNR by means of small pseudostochastic power oscillations. These power oscillations must be artificially induced but do not require an interruption of the normal plant operation. The accuracy could however still be further improved by an additional measurement of the fuel temperature with a special instrumentation.

38681 **Design rules for high temperature plant - the implications of recent research in relation to current practice.** Townley, C.H.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 1-3 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

An historical summary is presented of design rules for high temperature plant, leading to the rules applicable to high temperature reactors, particularly the liquid metal fast breeder reactor. Special attention is given to creep rupture properties of ferritic and austenitic materials used for the construction of components such as boilers and pressure vessels.

38682 (KFK-tr—576) **Radioactivity of long-lived nuclides in the primary circuit of the reactor BOR-60 during operation with defective fuel elements.** Gryazev, V.M.; Kizin, V.D.; Lisitsyn, E.S.; Polyakov, V.I.; Chechetkin, Y.V. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Internationales Buero/Uebersetzergruppe). Jun 1978. 21p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The summarized results of measurements of the enrichment and distribution of radioactive nuclides from corrosion and of fission products during the four years of operation of BOR-60, including a longer period of operation with detective fuel elements in the core, are presented. It is shown that for operation with approximately 1% leaking fuel rods radiation exposure becomes worse manily because of release and enrichment of cesium isotopes in the coolant. Of the other fission products, the largest contribution to the dose rate in pipework and components is given by ^{140}Ba / ^{140}La and ^{95}Nb. On operation with 0.1 to 0.2% of leaking fuel rods, this contribution is comparable to that of the corrosion products ^{60}Co and ^{54}Mn. The radioactivity of corrosion products in the circuit has not increased within the last three years and was about one order of magnitude lower than the theoretical values. The corrosion and fission products are nonuniformly distributed over the circuit. Concentration of ^{95}Nb and ^{60}Co in the pipe for 'cold' sodium is larger by a factor of 2 - 5 and of ^{140}Ba and ^{54}Mn by a factor of 10-20 than in the pipes for 'hot' sodium. Most of the cobalt was found to deposit in the heat exchanges. The effectiveness of emptying the pipes from coolant in order to reduce the dose sate is assessed.

38683 (NIIEFA-A—0340) **Electromagnetic pumps for fast reactors primary cooling circuits.** Andreev, A.M.; Bezgachev, E.A.; Karasev, B.G.; Kirillov, I.R.; Ogorodnikov, A.P.; Semikov, G.T. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1977. 24p. (In Russian). Dep. NTIS (US Sales Only), PC A03/MF A01.

The review of the electromagnetic pump development for the main loops of the powerful atomic energy stations with fast neutron reactors is presented. The calculation results of the cylindrical pump

at the p essure of $9x10^5$ Pa nad Na consumption of 15500 m^3/h are given. Its design is described, the comparison of three pump versions, differing by the coil cooling method: water, Na-K, nitrogen is considered. The design and insulating material choosing, cavitation aspects and pump electric power at emergency heating conditions are discussed.

38684 (NUREG/CR—0001) **Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system.** Sha, W.T.; Thompson, J.F. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 45p. (ANL—78-1). Dep. NTIS, PC A03/MF A01.

A formulation under development for a three-dimensional, time-dependent, compressible single-phase rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate systems is discussed. The governing equations of conservation of mass, momentum, and energy are treated as a boundary-value problem in space and an initial-value problem in time. The numerical solutions can be in either implicit or explicit form, each with a choice of central or upwind convective derivatives. Two general types of coordinate systems are considered, analogous to rectangular and cylindrical systems. Complicated cross-sectional rod-bundle geometries, such as hexagonal fuel assemblies used in the LMFBR, can be transformed into either rectangular or cylindrical coordinates with uniform mesh.

38685 (NUREG/CR—0785) **COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis.** Sha, W.T.; Domanus, H.M.; Schmitt, R.C.; Oras, J.J.; Lin, E.I.H. (Argonne National Lab., IL (USA)). Sep 1978. Contract W-31-109-ENG-38. 122p. (ANL—77-96). Dep. NTIS, PC A06/MF A01.

A mathematical model, COMMIX-1 Computer Program, for three-dimensional, transient, single-phase, thermal-hydraulic analysis of reactor components is presented. A set of governing equations for the conservation of mass, momentum, and energy is solved as a boundary-value problem in space and as an initial-value problem in time. The model can treat both continuum (e.g., reactor plenum) and quasi-continuum (e.g., rod bundles or fuel assembly) sodium systems. Volume porosity, surface permeability, and distributed resistance are used in the quasi-continuum approach, which alleviates two inherent deficiencies associated with conventional subchannel analysis; one is the approximation used in the formulation of transverse momentum equations, the other is its inability of handling reverse flow or recirculatory flow.

38686 (ORNL/TM—6609) **Characterization of time-independent properties of formed and welded pipe for breeder reactor applications.** McEnerney, J.W.; Sikka, V.K. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 122p. AT.

Welded pipes were procured to characterize their time-independent properties for breeder reactor applications. The pipes were 0.91-m-OD by 12.77-mm-wall by 1.83-m-long type 316 stainless steel with solution-annealed longitudinal seam welds made by the gas tungsten-arc (GTA) or submerged-arc (SA) processes with types 16-8-2 or 316 stainless steel, or with no filler metal. Nondestructive evaluation of the pipes included dimensional characterization, determination of weld ferrite number, and radiographic inspection. The dimensional evaluation indicated that the majority of the pipes did not fully comply with the commercial specifications for which they were procured. Based upon this evaluation, a recommendation is made that direct measurements in the restrained condition should be used to characterize pipe ends for weld fitup. three of the five pipes had a magnetically determined weld ferrite number of zero, while the other two had values of approximately 4 or less. Destructive evaluation of the pipes inluded metallographic characterization and ferrite content determination. The metallographic characterization included evaluation of both macro- and microstructure details. The microstructural analysis indicated that the welds contained mixed substructures which ranged from dendritic to cellular. The ferrite evaluation indicated that values obtained by calculation of the ferrite number from chemical analysis can be deceptive due to the effects of solution annearling and is also dependent upon dilution effects and the inclusion of nitrogen in analyses for GTA welds. Tensile testing of base-metal and weldment specimens in the as-received conditions was performed at room temperature, 427, 538, and 649°C, while reannealed specimens were tested at room temperature and 649°C.

38687 (ORNL/TM—6688) **Fuel pin simulators for sodium boiling tests in the THORS facility.** Gnadt, P.A.; MacPherson, R.E.; McCulloch, R.W. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 65p. AT.

The Breeder Reactor Program (BRP) at Oak Ridge National Laboratory (ORNL) requires high-performance, electrically heated fuel pin simulators (FPSs) to duplicate the configuration, heat flux profiles, and operational capabilities of nuclear fuel pins. These FPSs have been assembled into 19-pin bundles and operated to temperature levels sufficient to cause sodium boiling in the Thermal-Hydraulic Out-of-Reactor Safety (THORS) Facility at ORNL. This report describes the procurement, assembly, and evaluation of the FPSs and their subsequent operation in THORS as bundles 6A and 3C. The two test bundles operated for over 11,000 hr (total) in sodium at temperatures between 316°C (600°F) and 1010°C (1850°F). Over 60 tests were run to conditions where sodium boiling occurred. Boiling was usually sustained for a period of 10 to 30 sec. Several of the tests resulted in clad dryout (unstable) conditions. The bundle 3C FPSs contained a uniform-pitch Nichrome V heating element, and those in bundle 6A contained a constant-width, variable-pitch Pt-8% W heating element, which gave a chopped-cosine heat flux pattern to the FPS. A complete description of the two FPS designs is presented.

38688 (PB—284227) **Proceedings of the workshop on institutional alternatives for LMFBR development and commercialization held at the Mitre Corporation in McLean, Virginia on September 8 and 9, 1976. Final report.** (Mitre Corp., McLean, VA (USA). METREK Div.). Jul 1977. 513p. NTIS PC A22/MF A01.

The workshop assembled representatives of utilities, nuclear vendors, and government and research organizations to consider institutional issues of the development and commercialization of liquid metal fast breeder reactors (LMFBR). The document contains transcripts of the presentations as well as discussions in several topical areas. The Energy Research and Development Administration's LMFBR program was outlined. Several studies of the development and commercialization of light water reactors were presented as background and a basis of discussion. Nuclear technology development and commercialization in foreign countries were outlined in several presentations, suggesting alternatives for development of LMFBR technologies in this country. The critical stage appears to be the transition between R and D and commercialization, i.e., the first thirty commercial reactors, and the appropriate government role at this stage needs to be defined.

38689 (UTNL-R—0046, pp 23-31) **Analytical study of solids-gas two phase flow.** Hosaka, M. (Tokyo Univ. (Japan)). Jun 1977. (In Japanese).

From Meeting on heat and structures in nuclear engineering, and symposium on numerical analysis of transport and diffusion phenomena in nuclear engineering; Tokai, Ibaraki, Japan (16 Mar 1977).

Fundamental studies were made on the hydrodynamics of solids-gas two-phase suspension flow, in which very small solid particles are mixed in a gas flow to enhance the heat transfer characteristics of gas cooled high temperature reactors. Especially, the pressure drop due to friction and the density distribution of solid particles are theoretically analyzed. The friction pressure drop of two-phase flow was analyzed based on the analytical result of the single-phase friction pressure drop. The calculated values of solid/gas friction factor as a function of solid/gas mass loading are compared with experimental results. Comparisons are made for Various combinations of Reynolds number and particle size. As for the particle density distribution, some factors affecting the non-uniformity of distribution were considered. The minimum of energy dispersion was obtained with the variational principle. The suspension density of particles was obtained as a function of relative distance from wall and was compared with experimental results. It is concluded that the distribution is much affected by the particle size and that the smaller particles are apt to gather near the wall.

38690 **Water chemistry in the Dounreay prototype fast reactor (PFR) power station.** Melhuish, K.R.; Bray, J.A. (UKAEA, Dounreay. Nuclear Power Development Establishment). pp 63-76 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The water treatment plants comprise three stages: a pre-treatment plant to deal with the high organic loading arising from the moorland catchment area; a make-up plant which was originally a twin stream demineralisation unit, each stream comprising cation bed, anion bed and mixed bed; and a condensate polishing plant of the 'deep bed' type with pre-coat filters. There are two 50% flow candle filter units followed by three 50% flow cation topped mixed bed units. The use of austenitic steels in the superheater and reheater requires close control from the drum water content for sodium, chloride and oxygen to minimise the risks of chloride or caustic stress corrosion.

38691 **Results of acoustic and temperature noise measurements on sodium cooled electrically heated 7 rod bundle.** Biserna, T.; Cavallini, F.; Taglienti, S.; Tosi, V. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). pp 517-526 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Assembly cooling deficiency in a LMFBR is one of the most important safety problems for reactor design and operation. Studies on early detection and diagnosis of local accident by means of noise analysis techniques have been initiated at CNEN. Acoustic and temperature noise measurements have been carried out on a 7 rod bundle during slow power transients up to boiling conditions. The test section, simulating the Italian PEC reactor fuel element, was mounted on ENA-2 sodium loop located at the CSN Casaccia. Acoustic noise spectral analysis up to 32 kHz shows the appearance, in presence of boiling, of power increase at certain frequencies. Power spectra and rms values are updated and recorded every 0.3 sec and show large variations going from single phase to boiling. Temperature noise spectral analysis shows that the power, between 1 and 50 Hz, increases, in presence of boiling, by a factor bigger than 30. The sensitivity of other indicators of temperature fluctuations, like skewness and flatness, have been tested to reveal boiling.

38692 Noise and DC balanced outlet temperature signals for monitoring coolant flow in LMFBR fuel elements. Edelmann, M. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). pp 543-552 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Local cooling disturbances in LMFBR fuel elements may have serious safety implications for the whole reactor core. They have to be detected reliably in an early stage of their formation therefore. This can be accomplished in principle by individual monitoring of the coolant flow rate or the coolant outlet temperature of the sub-assemblies with high precision. In this paper a method is proposed to increase the sensitivity of outlet temperature signals to cooling disturbances. Using balanced temperature signals provides a means for eliminating the normal variations from the original signals which limit the sensitivity and speed of response to cooling disturbances. It is shown that a balanced signal can be derived easily from the original temperature signal by subtracting an inlet temperature and a neutron detector signal with appropriate time shift. The method was tested with tape-recorded noise signals of the KNK I reactor at Karlsruhe. The experimental results confirm the theoretical predictions. A significant reduction of the uncertainty of measured outlet temperatures was achieved. This enables very sensitive and fast response monitoring of coolant flow. Furthermore, it was found that minimizing the variance of the balanced signal offers the possibility for a rough determination of the heat transfer coefficient of the fuel rods during normal reactor operation at power.

38693 Noise analysis performed at the sodium cooled power reactor KNK 1 for malfunctioning diagnosis and plant surveillance. Hoppe, P.; Mitzel, F. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). pp 427-436 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

In order to use neutron noise analysis as an effective tool for early malfunction detection it is necessary to identify the driving forces and to calculate their contributions to the power fluctuations. In this paper the influence of a considerable number of measured noise sources on neutron noise within a large frequency range (10^{-2} Hz to 10^{3} Hz) is investigated for the sodium cooled power reactor KNK 1 (thermal core, 58 MWsub(th)). The experimental basis for the analysis is numerous records of the following signals at various power levels: neutron noise which has been measured with an in-core fission chamber and 3 ex-core ionisation chambers; the sodium inlet temperature and the coolant flow in both primary coolant loops and the movement of the control rods. In addition signals from acoustic-, seismic-and pressure transducers and the coolant outlet temperature were collected. The influence of the thermohydraulic- and of the control system on neutron noise has also been calculated by means of the relations for linear and multiple-input systems. Important for this analysis is the reactivity-power transfer function. Calculations of this function could be confirmed by measurements using a pseudo-random binary signal as reactivity input.

38694 Detection of local boiling in an LMFBR subassembly by temperature fluctuations analysis at the outlet. Krebs, L.; Weinkoetz, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). pp 507-515 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The aim of the experiments is to detect boiling in a sodium cooled subassembly by measuring fluctuations behind the bundle outlet. The measurements were carried out on an electrically heated 28-rod bundle with a partially blocked section. Fast responding thermocouples were installed downstream of the bundle outlet and downstream of a flow mixing system. Statistical parameters were investigated such as root mean square (RMS) and power spectrum density (PSD). The boiling conditions were generated by reducing the system pressure or flow velocity reduction. The experiments have shown that statistical analysis of temperature fluctuations can produce significant results in the detection of boiling behaviour at both the outlet of a subassembly, and behind a flow mixing system.

38695 Boiling detection in fast reactors by noise analysis studies performed in France. Le Guillou, G.; Berger, R.; Brunet, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 409-426 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The onset of accidental conditions particularly the boiling of sodium is generally related to background noise modifications in an operating reactor. The detection of in-core boiling may be achieved by three different analysis methods: neutron noise, acoustic noise and temperature fluctuations at the subassembly outlets. This paper deals with tests and measurements made in this field. The subject is discussed under the following headings: boiling in the loop (general description of experiments, detection of boiling by monitoring flow and pressure noises, detection of boiling by thermal noise analysis, acoustic detection of boiling); detection of boiling in the core: description of the 'NABO' experiment carried out on the reactor RAPSODIE (brief description of experiment, detection of boiling by neutron noise analysis, detection of boiling by acoustic noise analysis).

38696 Acoustic detection of boiling in LMFBRs: an estimate of sensitivity derived from experiments during the commissioning of PFR. Macleod, I.D.; Catling, E.; Taylor, C.G. (UKAEA Reactor Group, Springfields). pp 469-485 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

This paper describes a programme of experiments undertaken during the commissioning of the 600-MW PFR at Dounreay. The objective of the programme was to obtain data on reactor background acoustic noise levels and to estimate the sensitivity of the installed acoustic boiling detection system. The boiling-noise detection system installed in PFR consists of seven waveguides. The waveguides are solid metal rods which extend from the reactor top to just above the core top level. Five are arranged on a 0.75m radius circle with two at the edge of the core. The sensing elements are standard accelerometers. For the commissioning experiments three rigs were installed in the core locations below three of the waveguides. Each rig carried three sodium-proof microphones at levels corresponding to core top, mid-core and core bottom. Each rig also carried an electrically-powered vapour generator which could inject a stream of sodium vapour into the surrounding 250°C sodium, so producing a boiling type noise. In addition to these nine microphones in the core, microphones were also installed at the inlet and outlet of each of the three pumps. To handle the data for this experiment a system of amplifiers and three fourteen-track tape recorders were used. To check amplifier gains a calibration signal was automatically injected at the end of each record. On-line one-third octave and narrow band analysis was also available, but the bulk of the analysis was done from the tape records. The commissioning programme was in two parts: a measurement of background noise and an investigation of the detection sensitivity at the waveguides of the noise from the vapour generator (this implicitly included the transmission loss).

38697 Materials data for severe variable loading. Wood, D.S. (UKAEA, Risley. Nuclear Power Development Labs.). pp 65-70 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

The reversed strain behaviour of structural materials at temperatures in the creep range is an important materials parameter in sodium cooled fast reactors. Existing rules for designing against combined creep/fatigue are suspect due to lack of long term data. A UK programme of creep/fatigue tests is outlined which includes long term tests and a study of cast variations. It is believed that information from this programme should substantially improve our ability to provide design guidance against creep/fatigue damage.

38698 Detection of sodium vapor bubble collapse in a liquid metal fast breeder reactor. Carey, W.M.; Gavin, A.P.; Bobis, J.P.; Sheen,

S.H.; Anderson, T.T.; Doolittle, R.D.; Albrecht, R.W. (Argonne National Lab., Ill. (USA)). pp 437-468 of Reactor noise - SMORN II. Proceedings of the 2. specialists meeting on reactor noise, Gatlinburg, Tennessee, USA 19-23 September 1977. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford; Pergamon Press Ltd. (1977).

Sodium boiling detection utilizing the sound pressure emanated during the collapse of a sodium vapour bubble in a subcooled media is discussed in terms of the sound characteristic, the reactor ambient noise background, transmission loss considerations and performance criteria. Data obtained in several loss of flow experiments on Fast Test Reactor Fuel Elements indicate that the collapse of the sodium vapour bubble depends on the presence of a subcooled structure or sodium. The collapse pressure pulse was observed in all cases to be on the order of a kPa, indicating a soft type of cavitational collapse. Spectral examination of the pulses indicates the response function of the test structure and geometry is important. The sodium boiling observed in these experiments was observed to occur at a low ($<50°C$) liquid superheat with the rate of occurrence of sodium vapor bubble collapse in the 3 to 30 Hz range. Reactor ambient noise data were found to be due to machinery induced vibrations flow induced vibrations, and flow noise. These data were further found to be weakly stationary enhancing the possibility of acoustic surveillance of an operating Liquid Metal Fast Breeder Reactor. Based on these noise characteristics and extrapolating the noise measurements from the Fast Flux Test Facility Pump (FFTP), one would expect a signal to noise ratio of up to 20 dB in the absence of transmission loss. The requirement of a low false alarm probability is shown to necessitate post detection analysis of the collapse event sequence and the cross correlation with the second derivative of the neutronic boiling detection signal. Sodium boiling detection using the sounds emitted during sodium vapor bubble collapse are shown to be feasible but a need for in-reactor demonstration is necessary.

38699 Computer supervision of the core outlet sodium temperatures of FBTR. Boopathy, C. (Reactor Research Centre, Kalpakkam (India)). pp 86-90 of Nuclear reactor instrumentation. Vol. 1. Bombay; Department of Atomic Energy (1976).

From Symposium on nuclear reactor instrumentation; Bombay, India (20 Dec 1976).

Safety monitoring of the fast breeder test reactor at Kalpakkam (India) is achieved by a CDPS-on-line dual computer system which is dedicated to plant supervision. The on-line subsystem scans and supervises all the 170 core thermocouple signals every second. Organisation of the reactor core instruments, supervision of mean sodium outlet temperature and mean temperature drop across the core, detection of plugging of a fuel assembly are explained.

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

REFER ALSO TO CITATION(S) 38788

REGULATION AND LICENSING

38700 (HEDL-TI—75002-33) **Distribution of revisions to FFTF FSAR.** (Hanford Engineering Development Lab., Richland, WA (USA)). 12 Mar 1979. Contract EY-76-C-14-2170. 56p. AT.

Requested additional information is presented concerning the reactor protection systems and auxiliary equipment.

38701 (HEDL-TI—75002-34) **FSAR Amendment 34: environmental technical specifications for the Fast Flux Test Facility (Chapter 18).** Schade, A.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1979. Contract EY-76-C-14-2170. 67p. AT.

Requested additional information is presented concerning environmental surveillance procedures.

38702 (NTISUB/B/201—003-R5) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 3.9.2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1978. 18p. NTIS PC A02/MF A01.

Revision No.1 to Section 3.9.2 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

38703 (NTISUB/B/201—004-R3) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 4.2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1978. 17p. NTIS PC A02/MF A01.

Revision No. 1 to Section 4.2 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

38704 (NTISUB/B/201—006-R8) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 6.2.6.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1978. 8p. NTIS PC A02/MF A01.

Revision No.1 to Section 6.2.5 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

38705 (NTISUB/B/201—009-R9) **Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 9.4.1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1978. 10p. NTIS PC A02/MF A01.

Revision No. 1 to Section 9.4.1 of the Standard Review Plan incorporates changes that have been developed since the original issuance in September 1975, many of which are editorial in nature, to reflect current staff practice in the review of safety analysis reports for nuclear power plants.

PROCESS HEAT REACTORS

38706 (IAEA—206, pp 47-72) **Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants.** Edalat, M.; Mansoori, F.S.; Entessari, J.; Hamidi, H. (Atomic Energy Organization of Iran, Teheran). 1978.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

The requirements for electrical power and fresh water and the past and present desalination projects in Iran are discussed. The different methods usually employed in coupling the desalination plants with power plants are outlined, and the interdependency of the two plants and the safety aspects due to radioactive contamination are considered. Finally, the method utilizing a pressurized hot water loop as a safety barrier for the two proposed desalination plants to be coupled with the Bushehr Nuclear Power Plants under construction in Iran is described.

38707 (IAEA—206, pp 43-46) **Desalination projects in the Kingdom of Saudi Arabia.** El-Roumi, B. (Saline Water Conversion Corporation, Jeddah, Saudi Arabia). 1978.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

38708 (IAEA—206, pp 33-41) **Status of desalination projects in Iran.** Emani, M. (Atomic Energy Organization of Iran, Teheran). 1978.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

Iran, a country with a rapid industrial development and vast areas of arid zone has increasingly become an important market place for desalination, and in particular Nuclear one. The situation in arid zone areas of Iran is analysed. Past and present status of desalination, dual purpose plant and Nuclear desalination in Iran is discussed. Some aspects of different arrangements for heat extraction and combined systems and the Socio-economical impact of Nuclear desalination project for Iran is discussed.

38709 (IAEA—206, pp 95-108) **Small nuclear reactors for desalination.** Goldsmith, K. (Electro-Watt Engineering Services Ltd., London, UK); Arnott, P.T.W. (Electro-Watt Engineering Services Ltd., Zurich (Switzerland)). 1978.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

Small nuclear reactors are considered to have an output of not more than 400MW thermal. Since they can produce steam at much higher conditions than needed by the brine heater of a multi-flash desalination unit, it may be economically advantageous to use small reactors for a dual-purpose installation of appropriate size, producing both electricity and desalted water, rather than for a

single-purpose desalination plant only. Different combinations of dual-purpose arrangements are possible depending principally on the ratio of electricity to water output required. The costs of the installation as well as of the products are critically dependent on this ratio. For minimum investment costs, the components of the dual-purpose installation should be of a standardised design based on normal commercial power plant practice. This then imposes some restrictions on the plant arrangement but, on the other hand, it facilitates selection of the components.y and water will be different for the two cases, but the relation can be expressed in general terms to provide guidelines for selecting the best dimensions for the plant.

38710 (IAEA—206, pp 109-115) **Some considerations of operating nuclear powered dual purpose electricity/water installations.** Hooper, A.T.; Smith, J. (UKAEA, Winfrith. Atomic Energy Establishment). 1978.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

The problems of introducing nuclear dual-purpose plants into electrical and water systems which are growing but are still of moderate size are examined to see what influence this could exert on the acceptable size of unit, and on the mode of operation of which it should be capable. Both back-pressure and extraction turbines in conjunction with a distillation process of the multistage flash type are considered to see what flexibility of operation they can offer in these circumstances, together with the ways in which heat storage could be used to maintain high utilisation of the reactor. The ways in which power processes may be capable of improving reactor utilisation are referred to briefly also.

38711 (IAEA—206, pp 73-94) **Desalination applications of Thermos.** Labrousse, M. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Lauro, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1978. (In English and French).

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

Thermos (rated power 100MW) is designed to produce hot water (200°C) for district heating networks. The economic performance and safety characteristics of this reactor enable it to be adapted for freshwater production applications. A summary of the reactor's characteristics is given. Technical and economical problems arising from the coupling of Thermos with a desalination plant are presented here.

38712 (IAEA—206) **Heat utilization from nuclear reactors for desalting of sea water.** (International Atomic Energy Agency, Vienna (Austria)). 1976. 135p. (CONF-7706173—). Dep. NTIS (US Sales Only), PC A07/MF A01.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

Papers are presented concerning the economics and technical aspects of desalination reactors.

38713 (IAEA—206, pp 117-121) **Summary report and recommendations.** 1976.

From Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water; Vienna, Austria (29 Jun 1977).

38714 (INIS-mf—4376, pp 86-95) **Heat extraction from nuclear power plants.** Deuster, G.; Zenker, P. (Energieversorgung Oberhausen A.G. (Germany, F.R.)). 1977.

From Meeting on low temperature nuclear heat; Otaniemi, Finland (21 Aug 1977).

Todays marketable light water reactor nuclear power plants allow with an appropriate design the extraction of heat for the purpose of district heating. Next to the desired reduction of thermal emission the electrical output will thereby also decrease. With helium cooled high temperatur reactors or modified light water reactors nuclear generation of low temperature heat can possibly be made more economical. Some suggestions on extracting heat from steam circuits are presented and the costs are estimated. The presence of wide-spread district heat networks would allow distribution of more than 1.000 MJ/s from these power plants, but the desired saving of primary energy can be attained only by high investments.

38715 (INIS-mf—4494) **High-temperature reactor.** (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jun 1977. 8p. (In Czech). Dep. NTIS (US Sales Only), PC A02/MF A01.

A survey is presented of helium-cooled high-temperature reactors operated in the world. The fuel for these reactors, its production and costs are described in detail. Specifications are shown of the Dragon, AVR, THTR, Peach Bottom, UHTREX, Fort St. Vrain reactors. The application is described of the reactors in hydrogen and raw iron production.

38716 (Juel—1433) **ADAM I - methanation pilot plant.** Hoehlein, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jul 1977. 24p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

From the engineering point of view, the report gives a description of a Nuclear Long-Distance Energy Circuit for the example of a combined methane steam reforming/methanation reaction system. With the description of the pilot plant ADAM I, at present under construction in Juelich, the report points out to fundamental problems involved in the methanation process and indicates possible solutions. The experimental results achieved with the pilot plant ADAM I and the results of catalyst tests will contribute considerably to the optimization of the methanation process within the Nuclear Long-Distance Energy System.

38717 (ORNL/TM—6821) **Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant.** (Bechtel National, Inc., San Francisco, CA (USA)). Apr 1979. Contract W-7405-ENG-26. 130p. Dep. NTIS, PC A07/MF A01.

The objective of this study was to develop a conceptual design and cost estimate for a 25 million gallon per day seawater reverse osmosis desalting plant operating at both Caribbean and Persian Gulf sites. The plant would operate in conjunction with a 1000 MW(e) nuclear power plant. Four seawater membrane manufacturers were supplied with feedwater analysis and a simplified cost estimating procedure in order to recommend membrane systems which would be applicable. For both sites a two-stage system was selected for development of a conceptual cost estimate. The product water cost was found to be (based upon 1978 United States construction costs) $3.17/1000 gallons for the Caribbean site and $3.75/1000 gallons for the Persian Gulf site.

38718 (TECHNICATOME-CONF—77-1) **Thermos reactor.** Lerouge, B. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Apr 1977. 10p. (In French). (CONF-7706164—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 1. international meeting on new sources of energy; Paris, France (13 Jun 1977).

It is shown that the development of the process heat reactor 'Thermos' of 100MW(th), producing relatively low temperatures (120°C) is justified by a potential market. The design of the pool reactor was based on the following requirements: safety, reliability, low investment, low operating cost. Its environmental impact is particularly low: small dimensions, little thermal wastes, no chemical wastes, no radioactive wastes in normal operating conditions, reduced accidental wastes, little fuel transport. Other applications of this type of reactor are envisaged.

38719 **Metallurgical problems of the He-to-He heat exchanger for advanced HTR's.** Huddle, R.A.U. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center); Fricker, H.W. (Sulzer Bros. Ltd., Winterthur (Switzerland)). pp 212-216 of Advanced high temperature materials: technological and industrial aspects. Kroeckel, H. (ed.). Paris, France; Masson (1977).

From 1. colloquium on advanced high temperature materials; Petten, Netherlands (29 Jan 1976).

Possibilities of utilising nuclear energy as an alternative heat source for processes which require temperature in the range 750-900 deg C are examined. An intermediate heat exchanger is needed for safety and reliability. Minimum resistance to heat transfer with a maximum resistance to cross contamination between the HTR helium coolant and the process gases should be involved. Design and metallurgical requirements are studied. An example is given using different well known inconel or incoloy alloys.

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 38896

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 39941

38720 (AED-Conf—78-023-002) **Physical fundamentals of reactor engineering.** Zoller, P. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Energie-, Verfahrens- und Elektrotechnik). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 40p. (In German). (CONF-780272—1). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Meeting on reactor engineering and nuclear power supply; Essen, F.R. Germany (27 Feb 1978).

The paper is meant to be an introduction into reactor physics for educated laymen. Focal points are nuclear fission and subsequent energy release, controlled chain reaction as a precondition for the construction and operation of nuclear power plants, determination of critical reactor size and possibilities of reactor control.

38721 (INIS-mf—4052, pp 235-240) **Criticality calculations with various weighted difference equations.** Reiss, Y.; Wagschal, J.J. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1977.

From Meeting of the Israel Nuclear Societies Technion; Haifa, Israel (4 Dec 1977).

38722 (INIS-mf—4426, pp XI.1-12) **Neutronic studies for the design of irradiation devices.** Debrue, J.; de Raedt, C.; Fouarge, L.; Maene, N.; Menil, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

In the framework of the WRS (Water Reactor Safety) project of in-pile testing at the BR2 Reactor, in order to evaluate the behavior of PWR fuel rod bundles under abnormal operating conditions, neutronic studies have been done. The aim of these studies is to achieve appropriate irradiation conditions taking into account the core physics aspects and the reactor utilization programme. The main characteristics of the codes running on an IBM 370/168 computer are presented. The specifications for the neutronic studies in the WRS loop are given as well as the theoretical and experimental results in the irradiation of 21 and 45 rod bundles.

38723 (INS-R—230) **Nuclear energy from thorium. An introduction.** Coote, G.E. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Jun 1977. 34p. (INS—867). Dep. NTIS (US Sales Only), PC A03/MF A01.

Relevant topics in nuclear and reactor physics are outlined. These include: the thorium decay series; generation of fissile from fertile nuclides, in particular U-233 from Th-232; the principiples underlying thermal breeder reactors; the production of U-232 in thorium fuel and its important influence on nuclear safeguards and the recycling of U-233. Development work is continuing on several types of reactor which could utilise thorium; each of these is briefly described and its possible role is assessed. Other tipics covered include safety aspects of thorium oxide fuel, reprocessing, fabrication of recycle fuel and the possibility of denaturing U-233 by adding natural uranium. It is concluded that previoue arguments for development of the thorium cycle are still valid but those relating to nonproliferation of weapons may become even more compelling.

38724 (LA—7704-PR) **Transport and reactor theory. Progress report, October 1—December 31, 1978.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E.; Gomez, M.F. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 66p. Dep. NTIS, PC A04/MF A01.

Research and development in transport and reactor theory by Los Alamos Scientific Laboratory Group T-1 for the first quarter of FY-1979 is reported. The Supporting Research and Reactor Safety Section reports on results of extending the linear characteristic method to both two-dimensional x-y geometry and one-dimensional spherical geometry. Also reported are work on an exponential spatial difference scheme, an investigation of the convergence properties of the multigrid iteration method for the two-dimensional diffusion equation, and application of transport differencing and acceleration methods to the neutronics module of the SIMMER-II code. Results are given for the application of SIMMER-II to unprotected loss-of-flow accidents in advanced reactors. Tasks reported in the Fusion Reactor Nucleonics area include continued development of the two-dimensional, triangular-mesh, discrete-ordinates code, TRIDENT-CTR; implementation of the MCNP Monte Carlo code on the MFE computer; and fusion reactor systems studies for a Li boiler concept. Coincidence counter neutronics applications for the nuclear safeguards program, and a Monte Carlo perturbation modification to the calculations, are also reported. The implementation of the contribution Monte Carlo method for shielding calculations is discussed. Intranuclear-cascade/evaporation neutron source and transport calculations to determine detailed neutron flux spectra for the as-built LAMPF Radiation Effects Facility are presented. The Fission Reactor Neutronics Section reports on the results of comparisons of performance of two-dimensional, discrete-ordinates codes for fast reactor criticality calculations; work on the THREETRAN (hex,z) code; and progress with the discontinuous diamond-difference scheme for two-dimensional, orthogonal-grid spatial meshes. Maintenance and support of several other LASL codes is also discussed.

38725 (RD-B-N—4079) **User's guide to the reactor inventory code RICE.** Nair, S.; Henning, M.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1978. 117p. Dep. NTIS (US Sales Only), PC A07/MF A01.

A complete description is given of the input data requirements for the reactor inventory code RICE. Facilities for modifying temporarily the library and input data are described. Three sample cases are also included, both input and output, to facilitate programme testing. The three cases correspond to the three fundamentally different ways of running the programme, namely, to calculate actinide inventories only, to calculate fission product inventories only, or to calculate composite actinide-fission product inventories. RICE is written in Fortran IV (level H) and is compiled under release 20.6, OPT = 2 on the IBM 370/165 computer.

38726 (RISO-M—2132) **Nuclear power reactor technology. Work, experience and services offerede by Risoe National Laboratory.** (Risoe National Lab., Roskilde (Denmark)). Sep 1978. 29p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Risoe National Laboratory was established more than twenty years ago with research and development of nuclear reactor technology as its main objective. The Laboratory has by now accumulated many years of experience in a number of areas vital to nuclear reactor technology. The work and experience of, and services offered by the Laboratory within the following fields are described: Health physics site supervision; Treatment of low and medium level radioactive waste; Core performance evaluation; Transient analysis; Accident analysis; Fuel management; Fuel element design, fabrication and performance evaluation; Non-destructive testing of nuclear fuel; Theoretical and experimental structural analysis; Reliability analysis; Site evaluation.

38727 **Reactivity prediction of uniform PuO_2—UO_2-fueled lattices and $Pu(NO_3)_4$ solutions in light water.** Mohanakrishnan, P.; Huria, H.C. (Bhabha Atomic Research Centre, Bombay, India). *Nucl. Sci. Eng.;* **68**: No. 2, 220-226(Nov 1978).

A theoretical analysis of the reactivities of experimentally measured uniform light-water-moderated and -reflected PuO_2 in UO_2 lattices and $Pu(NO_3)_4$ solutions is presented. The mixed-oxide single-rod lattices are homogenized by the use of multigroup integral transport theory, and diffusion theory is used for the cylindrical core calculations. The cross sections are derived from the WIMS library. The homogeneous spherical $Pu(NO_3)_4$ solutions are analyzed by discrete-ordinates transport theory. Due to the small size of these asemblies, it is necessary that one-dimensional core calculations also be performed with a cross-section energy-group structure that can accurately represent neutron slowing down and thermalization at the core-reflector interface. Due to the uncertainty present in the Battelle Northwest Laboratories analyses of the mixed-oxide lattices, the agreement of predictions for these lattices with measurement is considered to be more satisfactory. These reactivity predictions agree generally within +0.6% of measurements for the mixed-oxide lattices and within 1% for the solution systems.

38728 **Reactivity effects and space-domain noise caused by randomly dispersed materials in a reactor core.** Van Dam, H. (Interuniversitair Reactor Instituut, Delft (Netherlands)). pp 273-282 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

An analysis is presented of reactivity effects and flux perturbations caused by random dispersal of material in a reactor core. This analysis is based on higher-order perturbation theory and is supported by computer calculations on ensembles of reactor cores with simulated random dispersal.

38729 **Diagnosis of subharmonic vibrations in rotating machinery.** Mott, J.E. (Technology for Energy Corp., Knoxville, Tenn. (USA)). pp 707-712 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The subject is discussed by reference to figures entitled as follows: an illustration of a shaft, mounted on rigid bearings, subjected to such a vibration; an illustration of fluid bearing whip; the displacement spectrum of an 1190 rpm (20Hz) pump with fluid bearing whip; an illustration of rubbing or dry frictional whip; the displacement spectrum measured by two sensors, located at the ten

o'clock and two o'clock positions, on a horizontal pump with rub; and the vector resultant of these displacements, portraying the effect of two rubbing conditions.

38730 Loose-parts monitoring: present status of the technology, its implementation in U.S. reactors, and some recommendations for achieving improved performance. Kryter, R.C.; Ricker, C.W.; Jones, J.E. (Oak Ridge National Lab., Tenn. (USA)). pp 667-672 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

At the request of the U.S. Nuclear Regulatory Commission, an assessment of the technical development status of loose-parts monitoring systems and their performance record to date in commercial light-water-cooled nuclear reactor plants was made during the spring of 1977, using an on-site personal interview and equipment demonstration approach. The study revealed that while presently demonstrated LPMS technology does indeed provide a capability for detecting the presence of those relatively massive loose parts that would likely constitute a serious operational or safety hazard to the plant, it unfortunately affords little information useful to the determination of the parts' safety significance and has not yet attained the levels of sophistication and reliability ordinarily associated with safety systems. Also found was a definite need for specification of the functional requirements for LPMS, in the form of a clear and comprehensive statement of NRC policy regarding the formulation and implementation of safety-orientated, yet operationally practicable, loose-parts monitoring programs for both existing and future nuclear generating stations so that overall objectives of both the utilities and the regulatory agency might be satisfied simultaneously. While it is considered that loose-parts monitoring programs providing reliable detection (but not characterization) capabilities could be implemented with today's technology, the path on which the nuclear utility industry should proceed in order to meet NRC expectations is not completely clear. A Regulatory Guide entitled 'Loose Part Detection Program for the Primary System of Light-Water-Cooled Reactors,' soon to be issued for public comment, constitutes a first step towards satisfying this need for guidance and goal establishment.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 38969, 39107, 39108, 39109, 39110, 39111, 39112, 39113, 39114, 39115, 39116, 39117, 39118, 39119, 39120, 39121, 39122, 39123, 39124, 39125, 39126, 39127, 39132, 39141, 39142, 39161, 39491, 39506

38731 (AECL—6184) **Vibration of heat exchange components in liquid and two-phase cross-flow.** Pettigrew, M.J.; Gorman, D.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1978. 20p. (CONF-780589—2). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Conference on vibration in nuclear plant; Keswick, UK (9 May 1978).

Heat exchange components must be analysed at the design stage to avoid flow-induced vibration problems. This paper presents information required to formulate flow-induced vibration excitation mechanisms in liquid and two-phase cross-flow. Three basic excitation mechanisms are considered, namely: 1) fluidelastic instability, 2) periodic wake shedding, and 3) response to random flow turbulence. The vibration excitation information is deduced from vibration response data for various types of tube bundles. Sources of information are: 1) fundamental studies on tube bundles, 2) model testing, 3) field measurements, and 4) operating experiences. Fluidelastic instability is formulated in terms of dimensionless flow velocity and dimensionless damping; periodic wake shedding in terms of Strouhal number and lift coefficient; and random turbulence excitation in terms of statistical parameters of random forces. Guidelines are recommended for design purposes.

38732 (AED-Conf—78-048-003) **Contribution from U.S. system suppliers to the power generating industry.** Wachniack, R. (Babcock and Wilcox Co., Barberton, Ohio (USA)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 10p. (CONF-780246—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International symposium on quality assurance; Bad Neuenahr, F.R. Germany (27 Feb 1978).

Quality assurance, like the nuclear regulation, is here to stay and industry is clearly aware of its impact on performance. Original resistance to quality assurance as a way of life in a technical business has evaporated and the early emphasis on paper and form has diminished. Quality assurance is being accepted as the proper concern of everyone in the business, whether they are engineering, manufacturing, purchasing, plant security, or the quality assurance department.

38733 (CEA-CONF—3997) **Neutronic control instrumentation of protection systems.** Furet, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 1977. 32p. (In French). (CONF-7705166—2). Dep. NTIS (US Sales Only), PC A03/MF A01.

From French-Soviet colloquium on the operation of power plants equipped with water reactors; Moscow, USSR (31 May 1977).

The aims of neutronic control instrumentation are briefly recalled and the present status of materials research and development is presented. As for the out-of-pile instrumentation, emphasis is put on the reliability and efficiency of the detectors and the new solutions of electric signal processing. The possible reactivity measurements at rest are examined. As for in-pile instrumentation results relating to mobile detectors of the type of miniaturized fission chambers are presented. The radiation tests on course of development for several years in the working conditions of neutron self-powdered detectors are analyzed so as to show that their use as built-in in-core instrumentation is to be envisaged at short term. Basic options inherent to the 'Nuclear Safety' philosophy that define the protection system are recalled. A definition and a justification of the performance testing of the instrumentation at rest and in-service are then derived.

38734 Structures subjected to severe loading conditions. Goodall, I.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 15-26 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

The paper reviews some techniques that are available for analysing structures that operate above the short term shakedown limit. A simple example of a tube subjected to internal pressure and thermal loading is used to illustrate some of the main features of the deformation. The paper is concluded by a consideration of some of the material effects that will influence the behaviour for loadings which cause an interaction between short term plastic deformation and time-dependent creep.

38735 Development of a monitoring device for noble gas nuclides in the stack effluent of a BWR nuclear power plant. Iimura, H.; Ishizuka, A. (Tokyo Electric Power Co., Inc. (Japan)); Koyama, H.; Ohtou, Y. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)); Kobayashi, A.; Ohhashi, H. (Tokyo Shibaura Electric Co. Ltd., Japan); Yuasa, Y.; Nagao, H. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). pp 279-293 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

A monitoring device for determining noble gas nuclides in the stack effluent of a BWR nuclear power plant has been developed. A combination of a Marinelli chamber, a germanium detector and a pulse-height analyser system was chosen for the device. Noble gases in the stack effluent of operating plants were measured with this device for more than half a year. It was found that the detection limit of the device was far less than the level that corresponded to 5 mrem/year of annual dose to the public. Total gamma-energy release rates (MeVμCi/s) from the stack were calculated from the measured nuclide concentrations, and were compared with the gross gamma counts data obtained with the conventional stack monitor. An approximately linear correlation was found between them during normal operation of the plant. This system can therefore be used as a device for calibration of the conventional stack monitor of a BWR power plant. This device itself also can be used as a continuous monitor for the gamma-energy release rate from the stack by combining it with a mini-computer system.

38736 (EPRI-WS—78-125) **Workshop proceedings: flow-induced vibrations.** Hetsroni, G.; Steininger, D.A. (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1978. 213p. (CONF-780880—). Dep. NTIS, PC A10/MF A01.

From Workshop on flow-induced vibrations; Palo Alto, CA, USA (21 Aug 1978).

The proceeding of a workshop of flow-induced vibration, principally in the area of nuclear reactor steam generator design, is presented. This workshop, intiated by the Electric Power Research Institute (EPRI) was attended by representatives of major nuclear reactor related companies and research laboratories. The objectives of the workshop were to: (1) identify the unresolved problems of flow-induced vibration in steam generator design; (2) outline the state of the art; and (3) define work required to eliminate unknowns and provide further understanding of flow-induced vibration phe-

nomena and its ramifications as related to steam genarator design and operation. A summary of each participants' presentation is given along with each participants' presented material, and an extensive list of developed references.

38737 Experience of measuring radioactive iodine by the cumulative method in gaseous discharges from nuclear power stations. Moravek, J.; Pietrik, I. (Vyskumny Ustav Energeticky, Bratislava (Czechoslovakia)); Hladky, E. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)); Feik, K. (Atomova Elektraren Bohunice, Jaslovske Bohunice (Czechoslovakia)). pp 195-202 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978). (In Russian)

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

Results are presented from the use of a detector operating on the basis of the accumulation of radioiodine in a trapping material which is placed in the well of a large-capacity scintillation detector. By using an inorganic sorbent - 'alumin' soaked in $AgNO_3$, and by measuring the accumulated iodine in an appropriate time limit it is possible to eliminate almost completely the influence of gaseous fission products and achieve a sensitivity of the order of 10^{-3}Bq/litre. A review is also made of the operational principle involved in an improved system for monitoring radioactive iodine in gaseous wastes which was developed on the basis of five years' experience.

38738 Determination of contamination in the air of reactor containment. Sampling and measuring techniques. Miribel, J.; Benezech, G.; Cerf, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Surete Nucleaire); Guirlet, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 127-139 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978). (In French)

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

For the purposes of radiological safety work, the most important elements emerging from the primary circuit and responsible for contamination of the containment are noble gases due to fission or activation, iodine in different physico-chemical forms, and tritium. Sampling and measuring techniques used in studies conducted on in-service reactors (pressurized-water and fast reactor plants) are described, together with the results obtained. The method used for measuring the activity of iodine in its different forms (penetrating or non-penetrating) is to trap the iodine by means of a selective sampling device. The measurements are then made by gamma spectrometry. The technique used for measuring the noble gases is to enrich the carrier gas by means of cold traps, and then to make measurements with an ionization chamber or by gamma spectrometry. Tritium is trapped by bubbling through water and its activity measured with a liquid scintillation detector or proportional counter.

38739 Approximate procedures in high temperature design. Leckie, F.A. (Leicester Univ. (UK)). pp 37-44 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

In this paper an attempt is made to review those procedures which have recently been developed to deal with load-bearing components which operate at temperatures sufficiently high (temperature greater than 0.3 of the metal melting temperature) for creep deformation and creep rupture to be of concern. The performance of components subjected to constant and variable load and temperature will be discussed, but it is assumed that the load and thermal variations are sufficiently small so that large reversals of strain are avoided.

38740 (INIS-mf—4506, pp v) **Two- and three-dimensional finite element analysis of a central cracked crackgrowth test specimen.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Stress analyses should take into account cracks and flaws in order to assess the safety of structural components. The linear elastic fracture mechanics provide a tool to deal with these phenomena by characterising the crack with its local stress field by means of the stress intensity factors Ksub(I), Ksub(II) and Ksub(III) for the different loading modes. In this paper several methods to extract K from the finite element results are applied and discussed for the case of the central cracked crack growth test specimen as used at ECN for crack growth experiments. The singular stress field is dealt with by means of distorted and collapsed isoparametric elements. The numerical results from three-dimensional analyses performed with the finite element program MARC are presented. In evaluating K special attention is given to the plane stress-plane strain state in these analyses as the stress state along the crack front varies from plane strain in the midplane through a three-dimensional state into a plane stress state at the surface. The effects of the thickness on the stress distribution and the stress intensity factors appearing from the numerical results are discussed. The different numerical procedures to estimate the Ksub(I) values all show a variation of the calculated Ksub(I) values along the crack front. The range of this variation depends upon the numerical procedure applied. The variation of G along the crack front is calculated according to the method proposed by Reynen (SMIRT-3 Paper G 5/1). A method using a modified Poissons ratio, the modification depending on the local stress state, is proposed in order to calculate Ksub(I) from the G value in this three-dimensional state.

38741 Estimation and reduction of errors in flow measurements which use cross-correlation techniques. Bazerghi, H. (Ecole Polytechnique, Montreal, Quebec (Canada)); Serdula, K.J. pp 629-648 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Propagation of inherent inhomogeneities or tracers in flowing liquids is used to measure flow. The peak value obtained from a cross-correlation analysis of downstream and upstream sensor signals is used to determine the tracer transit time and hence the flow. Performance of a 'clamp-on' ultrasonic cross-correlation flowmeter developed by Canadian General Electric under contract from Atomic Energy of Canada Limited (AECL) was evaluated at the Chalk River Nuclear Laboratories of AECL. During this work, the effects of: (1) cross-correlation parameters, (2) filtering of correlator output and (3) use of an add-only polarity coincidence correlator on the standard deviation of transit measurements were investigated both theoretically and experimentally. Comparison of ultra-sonic cross-correlation flowmeter readings against gravimetric flow measurements gave a standard deviation of 2% of reading.

38742 Vent-air monitoring in nuclear power plants by a nuclide-specific detection system. Becker, D.E.; Borst, H.; Grassl, P.; Kotschi, H. (Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)). pp 205-210 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

A nuclide-specific monitor for radioactivity in the vent air of nuclear power plants is a quantitative described. The system enables determination to be made of the nuclide composition in a continuously flowing air stream. The necessity for such an installation from the radiation protection point of view is explained. Installations in two West German plants are described, and the problems arising during routine operation are discussed.

38743 (SGAE—2820) **Principles of measurement and of safety surveillance for the PCPV/helium-loop.** Zemann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Oct 1977. 39p. (In German). (RS—120/77). Dep. NTIS (US Sales Only), PC A03/MF A01.

The operating conditions of the PCVP/Helium-Loop are surveyed by gauges within the structural concrete, inside the vessel and at the auxiliary equipment Data are compared by the operator to the limits given by design and material properties. Under continuous operation the PCPV will be surveyed by an automatic safety system which will be able to detect the arise of unsafe operating conditions and initiate preventive reactions.

38744 Iodine filter testing. Schnepf, R. (Electricite de France, 93 - Saint-Denis. Dept. de Radioprotection). pp 941-944 of Fourth international congress of the International Radiation Protection Association. Vol. 3. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977). (In French)

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

Iodine filters fit out many systems in nuclear power plants (air ventilation, carbon dioxyde blowing off) and must reduce iodine release in the environment. It is known from experience that efficiency of these filters decreases during time - either they are in operation or not - it is necessary to make sure periodically of their efficiency by representative testing. Theoretical studies and practical tests already performed have allowed to determine rules for in situ testing. The method consists in iodine admission above the filter. Above and below concentrations may be evaluated through samplings and their ratio give generally a good idea of the filter efficiency. Results observed on nuclear power plants of Electricite de France depend essentially on experimental circumstances, flow speed, temperature, humidity, kind of absorbing material, physical and chemical form of iodine (particulate, molecular or penetrating

form). Measured efficiencies have been observed between 100 and 1000. The required minimum being 100 for penetrating forms of iodine. Various parameters have great weight on the results, so it is necessary to define testing conditions in order to be as near as possible to actual way of filter utilization. A best knowledge of ageing phenomena must permit, in the near future, to determine the frequency of periodical testings.

38745 (UTNL-R—0046, pp 18-22) **Creep analysis in structures. Finite element creep buckling analysis of shallow spherical shells.** Miyazaki, N. (Tokyo Univ. (Japan). Faculty of Engineering). Jun 1977. (In Japanese).

From Meeting on heat and structures in nuclear engineering, and symposium on numerical analysis of transport and diffusion phenomena in nuclear engineering; Tokai, Ibaraki, Japan (16 Mar 1977).

Recently, the structures used at high temperature such as chemical plants and atomic power equipments increased, and the stress analysis taking creep, the deformation phenomenon depending on time, into account became more important. Shell structures are often used as structural elements because they have high loading capacity in comparison with the weight, but the buckling phenomenon depending on time called creep buckling comes into question. Namely, the possibility exists that in case of the shell structures continuously subjected to the load which does not exceed the critical static buckling load, the buckling may occur after the critical time has elapsed by the effect of creep. The study on the creep buckling of partial spherical shells has been scarcely carried out so far, therefore the creep buckling analysis by the finite element method was extended to the phenomena after buckling, and the elastoplastic creep buckling analysis was carried out on the partial spherical shells. The theory on stress-strain relation, displacement and the principle of virtual work, the procedure of calculation and the results of elastic and elastoplastic analyses are explained. The mode of the creep buckling of partial spherical shells fixed at the periphery and subjected to uniform external pressure was transilient buckling.

38746 **Residual stresses in a weldment of pressure vessel steel.** Gott, K.E. (AB Atomenergi, Nykoeping (Sweden)). pp 259-265 of Residual stresses in welded construction and their effects. Vol. 1. Papers. Cambridge; Welding Institute (1978).

From Conference on residual stresses in welded construction and their effects; London, UK (15 Nov 1977).

A study was made of the distribution of residual stresses around a typical weld from a light water reactor pressure vessel by an X-ray double-exposure camera technique. So that the magnitude, sign, and distribution of the residual stresses were as similar as possible to those found in practice, a wide, full-thickness specimen of A533B Cl 1 steel containing a submerged-arc weld was stress-relief annealed. To obtain a three-dimensional distribution of the stresses the specimen was examined at different levels through the thickness. Following the removal of material by milling, the specimen surface was electropolished to free it from cold work. Corrections have been made to take into account specimen relaxation. To completely define the original stress system it is desirable also to measure the change in curvature on removing a layer of material. Unless this is done assumptions must be made which complicate the calculations unnecessarily. This became apparent after the experimental work was completed. In the centre of the plate the methods of correction which can be used are sensitive to errors in the measurements. The corrected results show that the dominant residual stress is perpendicular to the weld. It is positive at the surfaces and negative in the centre of the plate. The maximum value can reach the yield stress. The residual stresses in the weld metal can locally vary considerably: from 100 to 350N/mm^2 over a distance of 5mm. Such large variations have been found to coincide with the heat-affected zones of the individual weld runs.

38747 **On-line computerized reactor noise, vibration and loose parts monitoring system.** Pekrul, P.J. (Atomics International, Canoga Park, Calif. (USA)). pp 665-666 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

The on-line Reactor Noise, Vibration and Loose Parts Monitor (VandLPM) described here will continuously monitor a plant for anomalous behaviour, become part of the plant instrumentation, and require no operator action unless a preset signal level is exceeded. This unit consists of piezoelectric sensors, preamplifiers, signal processor units, computers and other peripheral equipment, and provides on-line measurement without interference to normal plant operation.

38748 **Application of computer methods to creep analysis.** Lewis, D.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). pp 5-14 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

The paper reviews the computational aids now available to the designer of high temperature plant, where creep is of importance. Methods used are briefly described and an indication is given of the availability of computer programs. Some samples are given of typical applications.

38749 **Simplified methods for piping analysis in the creep regime.** Spence, J.; Boyle, J.T. pp 57-64 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

This paper is intended as an introduction to the problem arising in structural analysis of piping systems operating at elevated temperature where creep is of significance. It is emphasised that simplified methods are necessary in the initial design stages; examples of such methods are described. The paper is relatively non technical but sufficient references are given to discover the details in the literature.

FUEL ELEMENTS

38750 (NUREG/CR—0220) **Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis.** Lanning, D.D.; Barnes, B.O.; Williford, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1979. Contract EY-76-C-06-1830. 119p. (PNL—2692). Dep. NTIS, PC A06/MF A01.

The interpretation and verification of fuel centerline thermocouple data are analyzed. Two new concepts are discussed along with their application to in-reactor data from IFA-432, a heavily instrumented six-rod Halden reactor test assembly sponsored by the Nuclear Regulatory Commission. The main ideas presented in this report are that: it is more useful to plot resistance versus power than simply to plot temperature versus power; and the response of the centerline temperature to a linear power decrease is correlated to the rod's current resistance-vs-power behavior. Thus, the resistance-vs-power measurement can be verified by performing a linear power decrease and by plotting the temperature response.

CONTROL SYSTEMS

38751 (AECL—6212) **Spatial power control in large CANDU reactors: the whys and wherefores.** McDonnell, F.N.; Green, R.E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1978. 22p. (CONF-7806125—2). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 1978 annual conference of the Canadian Nuclear Association; Ottawa, Canada (11 Jun 1978).

The ratio R^2/M^2 (reactor core area/neutron interaction area), a measure of reactor core size, has increased by a factor of 6 as the CANDU reactor has evolved from NPD to the proposed PHW-1250 MWe design. Consequently, the various regions of the larger reactor cores are less tightly coupled. Another trend in CANDU design has been an increase in flux flattening in the reactor core, to increase the power form factor and hence power output from a given core size. This also decreases the coupling between core regions. In the early CANDU reactors (e.g. NPD, Douglas Point) little or no spatial control action was necessary. Bulk power control, based on out-of-core flux monitors, was sufficient. However, current CANDU reactors require spatial power control and use in-core flux detectors to provide the information on spatial power distribution required by the control system. In this paper we discuss the evolution of spatial power control in CANDU reactors and outline some of the methods used to assess the spatial controllability of current and future CANDUs. To illustrate the methods, reference is made to a recent assessment of the spatial controllability of a large CANDU-BLW reactor.

38752 (AED-Conf—78-155-027) **New and already approved - the power plant control system PROCONTROL K by Brown-Boveri.** Schumacher, R. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 10p. (In German). (CONF-7804102—30). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

The duty of the control system in power plants in to guide the process. With this a number of process states and process variables

are generated and continuously monitored depending on the different operational conditions. Thermal power plants represent such a high plant asset that outages or limitations in power generation have to be avoided. In addition, high utilization of the process engineering components has to be aimed at for economic reasons. This requires extensive monitoring. As this can no longer be achieved manually, automatic installations for process control are used, assisting the operator and helping him to perform direct and concentrated interventions in the process in case of disturbances.

38753 (AED-Conf—78-155-033) **Transmission and distribution of information in power plants.** Pinkernell, H. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 16p. (In German). (CONF-7804102—29). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

Operation of modern large-site power plants is no longer imaginable without facilities for automatic control. Brown-Boveri Company has developed a promising control system for power plants called Procontrol k. An essential piece of the system is DATRAS k, a digital bus-oriented data transport system for transmitting and distributing signals in power plants. DATRAS will save a large amount of cables and reduce the constructional effect. It offers opportunities for diagnosis and service and by means of continuous monitoring of all system components it will essentially improve plant availability.

38754 (HEDL-TME—78-103) **BICM-2 instrumented neutron absorber experiment.** Hollenberg, G.W.; Jackson, J.L.; Basmajian, J.A. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1979. Contract EY-76-C-14-2170. 61p. Dep. NTIS, PC A04/MF A01.

The BICM-2 Experiment yielded gas release, swelling pellet integrity, and tritium retention data for boron carbide and europium oxide operating at high temperatures. In addition, it provided information regarding the manner in which pins placed above-the-core performed and a continuous evaluation of in-core vent devices.

38755 Malfunction detection of nuclear reactor by dynamic data system methodology. Chow, M.C.; Wu, S.M. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering and Statistics); Cain, D.G. pp 595-602 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

A new time series modelling technique called Dynamic Data System (DDS) is applied to malfunction detection of the nuclear reactor by using operating neutron flux data. An AR model and an ARMA model are found adequate to characterize the normal and abnormal data respectively of fuel cycle Nos. 14, 15, and 16 from the High Flux Isotope Reactor (HFIR). Using an AR model the time of malfunction occurring at the 13th day of cycle No. 15 is detected by the estimated parameter. A malfunction detection scheme employing control chart is developed for diagnosis, surveillance and early malfunction detection of the reactor system for on-line application. A control chart is established from cycle No. 14 data and tested on cycle Nos. 15 and 16. It is shown that malfunction is clearly detected in cycle No. 15 while cycle No. 16 is free from malfunction.

38756 Nuclear power plant operational diagnostics and control. Kemeny, L.G. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). pp 735-745 of Reactor noise - SMORN II. Williams, M.M.R. (Queen Mary Coll., London (UK). Dept. of Nuclear Engineering) (ed.). Oxford, England; Pergamon Press Ltd. (1977).

From Specialists meeting on reactor noise; Gatlinburg, TN, USA (19 Sep 1977).

Before the end of the present century, a significant proportion of the world's needs for electrical energy will be supplied by nuclear power plant. The capital invested in these stations, as opposed to their operating costs, will be considerable. For this reason and to ensure their optimal and safe operation, both as individual units and in a generating network, computer based on-line monitoring, identification and control techniques will be associated with each nuclear plant.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38599, 39695

38757 (DOE/ET—0064/1) **Tennessee Valley Region: a year 2000 profile.** (Tennessee Valley Authority, Chattanooga (USA); Department of Energy, Washington, DC (USA)). Jun 1978. 199p. Dep. NTIS, PC A05/MF A01.

A study was undertaken to determine the potential radiological implications of nuclear facilities in the combined watersheds of the Tennessee and Cumberland rivers, an area covering portions of 7 states of varied topography. The regional population in 1970 was about 4.6 million and is expected to increase to about 7 million by the year 2000. A 1973 projection estimated the installed electric generating capacity of the region to increase from a 1970 value of 45,000 megawatts to a total of 222,000 megawatts by the year 2000. In that year, about 144,000 megawatts were projected to be nuclear plants. The profile of the Tennessee Valley Region in the year 2000, as drawn from this report, contains the essential data for calculation of the radiological dose from operation of nuclear facilities in that year. Those calculations are reported in the companion document, DOE/ET-0064/2. Specifically, Volume I establishes the parameters describing where the people live, what they eat, the activities in which they engage, and the environmental surroundings that enable an evaluation of the potential radiation dose to the population. Airborne radionuclides from nuclear facilities in this zone may enter the study area and be deposited on the ground, on growing food, and on water surfaces. Consideration was not given to waterborne radionuclides external to the study region. 17 references. (MCW)

38758 (DOE/ET—0064/2) **Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations.** (Tennessee Valley Authority, Chattanooga (USA); Department of Energy, Washington, DC (USA)). Jun 1978. 285p. Dep. NTIS, PC A13/MF A01.

A companion report, DOE/ET-0064/1, presents a geographic, cultural, and demographic profile of the Tennessee Valley Region study area. This report describes the calculations of radionuclide release and transport and of the resultant dose to the regional population, assuming a projected installed capacity of 220,000 MW in the year 2000, of which 144,000 MW would be nuclear. All elements of the fuel cycle were assumed to be in operation. The radiological dose was calculated as a one-year dose based on ingestion of 35 different food types as well as for nine non-food pathways, and was reported as dose to the total body and for six specific organs for each of four age groups (infant, child, teen, and adult). Results indicate that the average individual would receive an incremental dose of 7×10^{-4} millirems in the year 2000 from the operation of nuclear facilities within and adjacent to the region, five orders of magnitude smaller than the dose from naturally occurring radiation in the area. The major contributor to dose was found to be tritium, and the most significant pathways were immersion in air, inhalation of air, transpiration of tritium (absorption through the skin), and exposure radionuclide-containing soil. 60 references.

38759 (NUREG/CR—0454) **Effects of nuclear power plants on community growth and residential property values. Final report, September 30, 1977—November 15, 1978.** Gamble, H.B.; Downing, R.H.; Sauerlender, O.H. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Nov 1978. 98p. NTIS, PC A05/MF A01.

This study tested the hypothesis that nuclear power plants adversely affect community growth and residential property values in nearby municipalities. Total assessed real property values from 1960 to 1976 for 64 municipalities and market sales data from 1975 to 1977 on 540 single family dwellings formed the data base, which was within 20 miles of 4 nuclear power plants in the Northeast: Pilgrim, Millstone, Oyster Creek, and R. E. Ginna. Analysis of the time series data showed that the averaged annual growth rates of total assessed values, in real terms, were inversely related to distances from the plants, and that growth rates for the years following plant construction were higher than for the years before plant construction, with the largest growth rate increase observed in the host municipalities. Multiple regression analysis of the cross sectional data explained about 80 percent of the variation in housing prices. The plants exerted no influence on the price of housing. The original hypothesis is rejected.

SITING

REFER ALSO TO CITATION(S) 39710

38760 (NTIS/PS—78/1007) **Power plant siting (A bibliography with abstracts). Report for 1964-September 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 314p.

Abstracts pertaining to the siting of nuclear power plants, solar thermal power plants, ocean thermal gradient power plants, and coal fired utilities are presented. Emphasis is on nuclear power plant siting and includes siting of underground nuclear facilities. Subject areas covered include geology, seismology, safety, social effects, economics, and environmental impacts. Abstracts dealing with the siting of power plants in countries other than the U.S. are included. (This updated bibliography contains 310 abstracts, 56 of which are new entries to the previous edition.)

RADIOACTIVE EFFLUENTS

38761 Planning for unplanned releases. Eldridge, J.S.; Lyon, W.S.; Oakes, T.W. (Oak Ridge National Lab., Tenn. (USA)). pp 89-95 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

Prevention of unplanned releases of airborne or liquid radioactive contaminants becomes increasingly necessary for public acceptance of nuclear power as a replacement for conventional energy sources. Environmental surveillance programmes are able to prove compliance with regulations concerning radioactivity releases, and the analyses of data collected in such programmes may serve as indicators of low-level unplanned releases. Analytical radiochemistry utilizing modern instrumental techniques of high-resolution alpha- and gamma-ray spectrometry coupled with selected radiochemical procedures is used for qualitative and quantitative determinations of radioactivity in surveillance samples. By combining in a facility emergency plan the equipment, techniques and personnel used in the surveillance programmes, it is possible to respond to unplanned releases in an expeditious manner. The radiochemist in charge of routine analyses for surveillance samples has unique knowledge to assist in the investigation stage following major unplanned releases. With early planning, the team of management, health physicists and radiochemists can put together an emergency scheme to lessen the impact of unplanned releases.

38762 (KFK-EXT—30/78-1) Determination of the physico-chemical species of radioiodine in the stack discharge of nuclear power plants. Deuber, H.; Wilhelm, J.G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Apr 1978. 11p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The physico-chemical I^{131} species were determined in the stack discharge of a BWR power plant, which had been shut down because of an accident, and in the stack discharge of a PWR power plant. The duration of measurement was 8 and 49 weeks respectively. The percentage of particulate I^{131} was very small (mostly $< 1\%$). In the case of the BWR the proportion of inorganic I^{131} (I_2) was always less than 50%. With the exception of 4 weeks, of which 2 were part of the refuelling outage the proportion of inorganic I^{131} was also less than 50% in the case of the PWR. The average proportion of inorganic I^{131} was about 30% in both cases. It is proposed to use fractions of 50% for both inorganic and organic I^{131} in the calculations of the ingestion dose by I^{131}.

38763 (PB—285165) Rancho Seco building wake effects on atmospheric diffusion. Technical memo. Start, G.E.; Cate, J.H.; Dickson, C.R.; Ricks, N.R.; Ackermann, G.R. (National Oceanic and Atmospheric Administration, Idaho Falls, ID (USA). Air Resources Lab.). Nov 1977. Contract AT(49-25)-1004. 189p. NTIS PC A09/MF A01.

A series of 23 paired gaseous tracer releases at the Rancho Seco Nuclear Power Station in 1975 was the third of several tests designed to investigate the diffusion characteristics of the atmosphere under conditions of low windspeed and temperature inversion. This test also evaluated the effects of flow around buildings upon dilution of pollutants. Gaseous tracers were laterally dispersed about six times more than the expected amounts from Pasquill-Gifford curves of sigma-y. Most of this increase could be related to observed variance of the horizontal wind direction (meandering). For ground-level released the effective sigma-z values were 16 times greater than the corresponding values from the Pasquill-Gifford curves. Measured ground-level axial concentrations were about 75 times smaller than predicted by the Gaussian diffusion equation for a ground-level release when Pasquill-Gifford values of sigma-y and sigma-z were used. Systematic building wake cavity circulations distributed near ground-level released tracers and oil fog vertically throughout the zone in the lee of the containment and auxiliary buildings. This vertical flux of material redistributed material so that the plume mass occurred at a greater height than expected for the height of release. Data representing the findings of this test series are presented in appendices.

38764 Control of liquid radioactive effluents from nuclear power plants in the Federal Republic of Germany. Franzen, L.F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)); Mueller, B. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.)); Sitte, R. (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). pp 457-475 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The early nuclear and water appropriation procedures for nuclear power plants provided release limits for liquid radioactive effluents expressed as total activity levels (without tritium) and tritium levels and/or concentration levels. This approach also determined the control methods to be applied. In the meantime, more detailed control methods and requirements were developed including a system of sampling of radioactive materials containing water, storing of the samples for providing evidence, performing total gammma and nuclide-specific measurements, and assessing the actual releases of radioactive materials in comparison with prescribed release limits. From this background, a safety guide on the liquid radioactive effluents was developed. It covers, in addition to radioactive waste water, plant service water, turbine building discharge and also the main cooling water. Within the framework of the guide, measurements for deciding on radioactive waste-water releases, the determination of the concentration of radioactive materials in releases, the nuclide-specific measurements and release assessments, the establishment of threshold values for initiating safety actions, and the quality assurance programme for the measuring equipment is discussed. The reporting system for liquid radioactive effluents is demonstrated by the example of an actual radioactive release report. Compliance with the guide requirements produces an integral control system for all liquid radioactive effluents of nuclear power plants.

38765 Experience in monitoring radioactive liquid effluents from nuclear facilities in the Federal Republic of Germany. Gans, I. (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). pp 523-539 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The Institute for Water, Soil and Air Hygiene has been engaged in a research and development project on monitoring radioactive liquid effluents since 1969. A method for composite sampling on a weekly basis was developed, and analyses for specific radionuclides performed on samples from all nuclear power plants in the Federal Republic of Germany since 1972. Analytical data from gamma emitters, strontium isotopes, tritium and alpha emitters are stored in the emission information system EMIS, and evaluated routinely and for particular problems. Analytical procedures for ^{32}P, ^{63}Ni and ^{14}C are being tested for general use. The results of analyses are given, and experiences and future developments with a central laboratory are discussed.

38766 Monitoring, evaluation and reporting of radioactive liquid and gaseous effluent releases from the CEGB nuclear power stations. Groom, D.J. (Central Electricity Generating Board, London (UK)). pp 63-73 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The method adopted in the United Kingdom for authorizing discharges of radioactive effluents is briefly reviewed. A distinction is drawn between the quantitative limits given for liquid effluents and the control of gaseous discharges by the 'best practicable means'. The source and nature of liquid and gaseous radioactive effluents that arise from gas-cooled reactor operation are described. For radioactivity in liquid effluent the amount that has been discharged annually in the last three years is compared with the authorized limit. The estimated maximum annual radiation dose received by an individual as a consequence of liquid and gaseous effluent discharges is given for each station. The stations and the 'independent laboratories' routinely participate in intercomparison counting exercises; typical accuracies are given. These exercises and the isotopic analysis programme provide assurance on the accuracy with which radioactive discharges are determined. The method by which the Central Electricity Generating Board (CEGB) disseminates information to local people and to the general public is described. It is concluded that radioactive effluent discharges from the Board's nuclear power stations give rise to acceptable radiation doses to members of the general public, and that the doses are for the most part too small to be meaningfully quantified.

38767 Problems of monitoring radioactive effluents. Grummitt, W.E.; Lahaie, G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). pp 9-17 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The technical aspects of monitoring effluent wastes from a nuclear establishment are described. The errors in specific procedures from inadequate sampling, non-uniform mixing and retention on walls of vessels during storage and sample preparation, have been investigated. Procedures which reduce losses and errors to a mini-

mum are outlined. Water outfalls at the Chalk River Nuclear Laboratories (CRNL) of Atomic Energy of Canada Limited (AECL) are sampled before release to the Ottawa River, either with an auto-sampling device that collects a sample proportional to flow rate, or by an operator who collects a sample manually. Loss of radioactivity occurs on the walls of the auto-sampler and the storage bottle as well as in most methods of sample concentration. These losses have been investigated, and results are given for a range of fission products and neutron capture nuclides. Losses resulting from evaporation and ashing are large, more than half of the nuclide being retained on the walls in some cases. The effects of surface treatment and aqueous pH on the stability of radioactive solutions have been investigated. Treatment of the vessel walls with aqua regia before use substantially reduces losses. Reduction of sample volume by evaporation and by ion exchange has been considered in detail. Methods are outlined which give >99% recovery for all nuclides of interest.

38768 Concept for the monitoring of airborne radioactive effluents from nuclear plants in the Federal Republic of Germany with application to the Juelich Nuclear Research Center. Heinemann, K.; Vogt, K.J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Strahlenschutz). pp 43-53 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

In the Federal Republic of Germany, airborne radioactive releases from nuclear facilities are limited by the dose limits specified in the Radiation Protection Ordinance. These limits are applicable to sites and not to individual plants. Allowing for a pre-exposure these values must not be exceeded at the most unfavourable location. Using the methods described in the General Calculation Criteria, secondary limits for the annual release of each nuclide may be derived from the predetermined primary dose limits by means of the diffusion calculation. This is done on the assumption that the release rate is constant in terms of time. For non-constant release rates, special regulations are applicable. In the event of several nuclides released simultaneously, a sum formula must be applied. A further requirement of the Radiation Protection Ordinance stipulates that the quantities released should be as low as possible. After the discussion of general requirements, the concept for the monitoring of radioactive releases at the Juelich Nuclear Research Center is presented. In a co-ordination plan, a specific portion of the dose limit is allocated to each nuclear facility releasing radioactivity with the waste air. To enable long-range planning to be undertaken, this co-ordination plan includes even those facilities that will emit radioactive substances at a later date only. After a description of the measuring appliances, the three most important objects of release monitoring are illustrated: identification at the appropriate time of any increase in release rates, adherence to licensing values, and provision of data for calculating the environmental radiation exposure. In conclusion, an example is given to demonstrate that the dose limits stipulated in the Radiation Protection Ordinance are adhered to.

38769 Monitoring of radioactive airborne releases in the NRI Rez. Horyna, J.; Razga, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). pp 55-61 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

A limited quantity of wastes may be disposed of by release to the atmosphere in order to maintain the exposure of the public at acceptable levels. These limits are established by state agencies. A system for monitoring airborne releases to provide assurance of compliance with authorized limits and to give warning of unplanned release is described. A scheme for setting investigation levels and operational working limits is presented. Measuring devices giving warning signals of exceeding these levels are described.

38770 Monitoring procedures for effluent releases from nuclear facilities at Trombay. Kotrappa, P.; Vashi, V.D.; Kolhatkar, M.G.; Sundaram, M.; Dabhadkar, S.B. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). pp 77-86 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The main aim of the effluent monitoring programme in the Bhabha Atomic Research Centre (BARC), Trombay, is to obtain data on the nature and quantities of radioactive materials released from the various facilities into the environment, and to ensure that the releases are well within permissible limits. A wide spectrum of monitoring methods is used in the various facilities at Trombay. The techniques used in situ and the laboratory methods employed for measuring the airborne and liquid releases from the facilities at BARC are described. The types and levels of radioactivities involved, the salient features of the effluent monitoring programme with special reference to the CIRUS reactor, the radiological laboratories, the fuel reprocessing plant, and new facilities being planned at Trombay, are outlined.

38771 Radioactive effluent discharges. Intercomparability of data. Luykx, F.; Fraser, G. (Commission of the European Communities, Luxembourg). pp 413-421 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

For some years the Commission of the European Communities has been publishing reports on radioactive discharges from nuclear power stations in the Member States. The compilation of these reports has highlighted the lack of uniformity at national and international level in the presentation of discharge data. Examples of the problems are given, and their origins and significance discussed. A justification for and a possible approach to harmonization are then presented.

38772 Monitoring of gaseous and liquid effluent releases at French nuclear power stations. Martin, J.J. (Electricite de France, 93 - Saint-Denis. Dept. de Radioprotection). pp 479-488 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978). (In French)

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

After a brief list of the characteristics of the nuclear power stations operated by Electricite de France, some information is given on the composition and activity of the radionuclides released in gaseous and liquid effluents. A description is given of the monitoring and release procedures applied consistently at the power plants. The gaseous effluents are monitored, in each stack, by continuously taking isokinetic samples of the gas to be tested. The sample passes, in parallel, through a compensated circulatory ionization chamber, which gives a direct measurement of the bulk activity of the gas, and through a unit consisting of a filter paper and a charcoal trap, which is measured in the laboratory on a weekly basis (gross beta measurement for aerosols and gamma spectrometry for volatile products). A GM counter positioned opposite the filter and trap unit triggers an alarm if the deposited activity increases too sharply. All the liquid effluents are collected, following any treatment required, in monitoring tanks. When a tank is full its contents are homogenized by stirring, after which a sample is taken for laboratory measurements (gross alpha, beta and gamma counting, gamma spectrometry and tritium and strontium-90 measurements). Tests verifying these measurements, both inside and outside the facility, provide a guarantee that the resulting data for effluents released by the power stations are valid.

38773 Monitoring of radioactive waste discharges from Tarapur Atomic Power Station (TAPS). Nandwani, T.B. (Tarapur Atomic Power Station (India)). pp 29-41 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

Methods and means of monitoring planned radioactive liquid as well as gaseous wastes discharged by TAPS to the environment are described and discussed. Liquid active waste is processed on a batch basis. A fast method standardized for identification and estimation of radionuclides present in the waste batch sample is presented and discussed. The method used for monitoring of gaseous and particulate activity releases is also discussed. As a safeguard for control purposes, various process radiation monitors on process liquid and gas streams are provided on all potential pathways for release of activity. The purpose and location of all these monitors are described together with calibration of and variables affecting the functioning of these monitors.

38774 General principles of organization and design of monitoring programmes. Rossbander, W.R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). pp 435-445 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

After a short outline of the reasons for and aims of effluent monitoring for different nuclear facilities including nuclear power stations, fuel reprocessing and waste treatment facilities, plutonium

handling facilities, research reactors, radiochemical facilities, uranium handling facilities and particle accelerators, types of airborne and liquid effluents are described together with the principal procedures for organizing monitoring programmes. Furthermore, for these types of nuclear facilities the most important aspects of effluent monitoring design are dealt with for airborne as well as liquid effluents. The report is based on the work of an IAEA advisory group and reflects its recommendations.

38775 Control of airborne radioactive releases from nuclear power plants in the Federal Republic of Germany. Schmitz, G. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)); Jacquemin, J. (Ministerium fuer Arbeit, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.)). pp 447-455 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

In accordance with the requirements of the Radiation Protection Ordinance in the Federal Republic of Germany, it is the responsibility of the operating organization of a nuclear power plant to keep the radiation exposure and contamination of persons and of the environment as low as possible. As a consequence, the released activity must be as low as possible, and must be monitored through the use of appropriate measuring equipment. To define the requirements of the Radiation Protection Ordinance in more detail, the Nuclear Safety Standards Commission (KTA) is establishing a safety standard on the measurement and monitoring of gaseous and aerosol-bound radioactive releases through the stack, based on guidelines issued by the Federal Ministry of the Interior.

38776 Effluent monitoring: Its purpose and value. Schoen, A.A. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Operational Safety). pp 3-7 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The purpose of effluent monitoring is described in terms of the primary objectives, the most important of which is to verify that the facility is functioning as it was designed and that the waste treatment and effluent control systems are performing as planned and expected. The object of a monitoring programme should be periodically re-examined to ensure that the programme serves a contemporary purpose. The value of the effluent monitoring programme is determined by the extent to which users of the monitoring data, i.e. the operator, the regulating authorities and the public, accept the result as indicating that the plant is operating safely, and in an environmentally acceptable manner. The credibility of the monitoring results is therefore the most important factor determining the value of an effluent monitoring programme.

38777 Monitoring of airborne releases from LWR power plants in the Federal Republic of Germany. Winkelmann, I. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.)); Jagersberger, H. (Kraftwerk Union A.G., Offenbach am Main (Germany, F.R.)). pp 19-26 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

From the radiological point of view a nuclear power plant has only one point of contact with the surrounding atmosphere - the stack. Considerable amounts of air are used for cooling and ventilation purposes. On passing through the plant the air is contaminated by minute amounts of radioactive substances. These contaminants and noble gases intentionally released are transferred to the environment via the stack. As the releases are to be kept as low as possible (they must not exceed certain limits) a means of measuring the release rate has to be provided - the stack monitoring system. Maximum permissible release rates are stipulated in the licensing procedure of a plant. In the Federal Republic of Germany, a nuclear facility may not produce a radiation exposure of the public of more than 30 mrem annually. Taking into consideration the fact that different types of nuclear establishments result in different types of radiation exposure, the legal requirements have to be interpreted in terms of technical specifications. As a major subject of interest, the light-water-cooled power reactors have been given technical standards in order to comply with the '30 mrem in a year' concept. The legal situation and the technical aspects with regard to stack monitoring systems in the Federal Republic of Germany are described briefly. In particular, the so-called 'Stack-Guideline' and the requirements stated therein are discussed. This Guideline provides a framework for the design of stack monitoring systems; it is applicable to light-water-cooled reactors only. Furthermore, technical approaches and solutions are mentioned in connection with a survey of the present situation in the Federal Republic of Germany; methods of measuring radioactive noble gases, aerosols, iodine-131 and tritium are mentioned.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 39557, 39628

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 38673, 38700, 38701, 38795

38778 (HEDL-SA—1671) **Status of FFTF startup program and future FFTF utilization.** Hard, E.N.; Bliss, R.J.; Olson, O.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1978. Contract EY-76-C-14-2170. 52p. (CONF-7810144—1). Dep. NTIS, PC A04/MF A01.

From Meeting of Japan section of the American Nuclear Society; Tokyo, Japan (25 Oct 1978).

Portions of document are illegible.

A brief FFTF project description is provided which includes general plant siting information, general layout, plant design parameters, description of principal systems and components, and description of support facilities. The current status of the FFTF project is provided, including status of plant construction, overall status of the plant checkout and test program, status of operating authorization and plant operating procedures and personnel, and status of reactor core components and experiments. Specific information on the acceptance test program and early program results is discussed. The role of FFTF in the future breeder program is described, including its objectives for verification of plant system and components designs and operability and use as an irradiation test facility.

38779 (IAEA—208(Vol.2), pp 117-176) **Coupled Fast Reactivity Measurements Facility (CFRMF).** Rogers, J.W.; Harker, Y.D.; Millsap, D.A. (EG and G Idaho, Inc., Idaho Falls (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1978.

From Consultants meeting on integral cross section measurements in standard neutron fields; Vienna, Austria (15 Nov 1976).

This is a description, application and performance evaluation of the Coupled Fast Reactivity Measurements Facility in relation to reactor dosimetry. Methods and data related to physical description, flux spatial distribution, integral testing of the spectrum, spectrum measurements, theoretical calculations and measured vs calculated reaction rates are covered. More detailed information may be found in Nuclear Technology, Volume 25, Number 2, February, 1975.

38780 (NUREG/CR—0643) **Material compatibility tests for LOFT nuclear reactor fuel centerline thermocouples.** Chan, A.I.Y.; Meyers, S.C.; Beutler, P.S. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1979. 70p. (HEDL-TME—78-75). NTIS, PC A04/MF A01.

High-temperature (2200°C) compatibilty tests were conducted at the Hanford Engineering Development Laboratory (HEDL) to select proper materials for commercial fabrication of fuel centerline thermocouples for Loss of Fluid Test (LOFT) reactor use. Materials investigated include the following: (a) beryllia (BeO), thoria (ThO_2) and hafnia (HfO_2) insulators, (b) molybdenum 48% rhenium (Mo48Re), tungsten 22% rhenium (W22Re), rhenium (Re), and rhenium/tungsten-augmented (Re/W-augmented) sheaths; (c) tungsten 3% rhenium versus tungsten 25% rhenium (W3Re/ W25Re) and tungsten 5% rhenium versus tungsten 26% rhenium (W5Re/ W26Re) thermoelectric wires. Candidate materials had to withstand temperatures of up to 2200°C, pressures up to 17.2 MPa and neutron fluences of 7.2×10^{19} nvt.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 38755

38781 (INIS-mf—4426) **BR2 reactor review meeting, Mol June 1, 1978. Tool for advanced nuclear research. Results and perspective of joint Belgo—German reactor utilization.** (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1978. 220p. (In Russian). (CONF-7806122—). Dep. NTIS (US Sales Only), PC A10/MF A01.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

Separate abstracts are included for the individual papers presented.

38782 (INIS-mf—4426, pp X.1-24) **Irradiation techniques at BR2 reactor.** Hebel, W. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop); Planquart, J.; Vanmassenhove, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

Since 1963 the material testing reactor BR2 at Mol is operated for the realisation of numerous research programs and experiments on the behavior of materials under nuclear radiation and in particular under intensive neutron exposure. During this period special irradiation techniques and experimental devices were developed according to the different experiments and to the irradiation possibilities offered at BR2. The design and the operating characteristics of quite a number of those irradiation rigs of proven reliability may be used or can be made available for new irradiation experiments. A brief description is given of some typical irradiation devices designed and constructed by CEN/SCK, Technology and Energy Dept. They are compiled according to their main use for the different research and development programs realized at BR2. Their eventual application however for different objectives could be possible. A final chapter summarizes the principal irradiation conditions offered by BR2 reactor.

38783 (INIS-mf—4426, pp XIII.1-33) **General outline of the operation and utilization of the BR2 reactor.** Baugnet, J.M.; Leonard, F. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Gandolfo, J.M.; Lenders, H. (Commission of the European Communities, Brussels (Belgium). Committee on Energy, Research and Technology). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

The BR2 reactor is a high-flux material testing reactor of the thermal heterogeneous type. The fuel is 93% ^{235}U enriched uranium in the form of plates clad in aluminium. The moderator consists of beryllium and light water, the water being pressurized (12.5kg/cm^2)and acting also as coolant. The pressure vessel is of aluminium, and is placed in a pool of demineralized water. One should stress the following main features of the design: the experimental channels are skew, the tube bundle presenting the form of a hyperboloid of revolution (see figure 1)-this gives easy access at the top and bottom reactor covers allowing complex instrumented devices, while maintaining a very high neutron flux at the core; great flexibilty of utilization, due to the fact that it is possible to adapt the core configuration to the experimental loading as the fissile charge can be centred on different experimental channels; although BR2 is a thermal reactor, it is possible to achieve neutron spectra very similar to those obtained in a fast reactor, either by the use of absorbing screens or by the use of fissile material within the experimental device; five 200mm diameter channels are available for loading large experimental irradiation devices, as in-pile sodium, gas or water loops.

38784 (KFK-EXT—15/78-1) **Operation and utilization of the FR2 in 1977. Abbreviated version.** Bluemle, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. Reaktorbetrieb und Technik). Jun 1978. 104p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

In its twelfth year of operation after the increase in power to 44 MW, the FR2 reactor again was operated at that design power according to schedule. The utilization of the reactor time at full power relative to the scheduled period of full power operation was 88% in 1977, the power output was 10,066 MWd. There were no major difficulties affecting reactor operation. Use of the reactor for experimental purposes again was good. Isotope production including irradiation of silicon for doping purposes for the production of semiconductors reached the level of the previous year. The production of fission product molybdenum medicine has shown a promising start. 20 experiments in the research areas of nuclear solid state physics and structural analysis (neutron diffraction) are attached to the beamhole outlets, some of them operated in the beamhole sharing mode. Up to 8 instrumented fuel capsule rigs and 3 pre-irradiation rigs were simultaneously loaded in the reactor core within the framework of the LWR Safety Program. Operation of the four large scale loop experiments proceeded according to schedule. While the superheated steam high pressure loop is becoming more and more important for purposes of the LWR safety program, the pressurized helium gas loop previously used for the Fast Breeder Project was decommissioned on May 2, 1977. In the way of this decommissioning also the thermionic converter, although still functioning, was removed after an unexpected in-pile time of some 31.800 hours of operation (N > 43 MW). The neutron radiography system was used for 176 pictures of test specimens, capsule rigs and biological material in the year under review. The γ-in-pile rig was used to capacity, holding 35 samples examined to study the radiation resistance of various materials. 24 argon samples were extracted from the gas activation system for a program of measuring two-phase flows.

38785 (UNI—1197) **Radiation exposure usage accountability and impact with respect to ALAP (ALARA) analysis.** Williams, M.C. (United Nuclear Industries, Inc., Richland, WA (USA)). 27 Nov 1978. Contract EY-76-C-06-1857. 14p. Dep. NTIS, PC A02/MF A01.

A unique method has been developed for radiation exposure usage accounting at the N Reactor. This method accounts for exposure usage by specific job and working crafts. The accounting system provides information for use in job planning, exposure resource management, and ALAP (ALARA) analysis. It provides justification for ALAP expenditures, documentation of the effectiveness of exposure reduction efforts, and can be used to establish priorities for ALAP efforts.

PROPULSION REACTORS

38786 (GKSS—77/E/35) **Gases and corrosion products in the primary circuit of the NS 'Otto Hahn'.** Reinhardt, K.H.; Smith, I.J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). Mar 1977. 9p. (In German). ZAED.

In cooperation between the Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt (GKSS) and the British atomic energy agency UKAEA gases and corrosion products have been measured in the primary system of the 'Otto Hahn' for a longer period of time. The investigations were carried out with the aim to gain information on the mechanism of those processes that influence the transport of corrosion products in the primary system and, if possible, to find means to reduce activity build-up.

38787 **NS Otto Hahn: operational chemistry of the primary and secondary circuits.** Smith, I.J. (UKAEA, Risley. Nuclear Power Development Establishment); Reinhardt, K.H.; James, H. pp 467-477 of Water chemistry of nuclear reactor systems. London, England; Thomas Telford for BNES (1978).

From International conference on chemistry of nuclear reactor systems; Bournemout, UK (24 Oct 1977).

The studies of gas and corrosion product behaviour in the primary and secondary circuits that were made following the second reactor core start-up are presented. The processes of mass and activity transfer, and gas production are considered for both circuits together with the performance of the primary circuit mixed bed. The preliminary results of analyses of in-core crud deposits are also included.

38788 **Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission).** Schneider, R.T. (U.S. Office of Naval Research, London); Thom, K.; Helmick, H.H. pp 45-59 of Space and energy. Napolitano, L.G. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 26. International Astronautical Congress; Lisbon, Portugal (21 Sep 1975).

Gaseous core reactors and nuclear pumped lasers have the potentials of space propulsion at exhaust jet velocities up to 50,000 m/sec, space power at 1 kg/kW specific mass, power transmission via laser beams over astronomical distances and beneficial applications on earth. In experiments conducted jointly by the University of Florida and the Los Alamos Scientific Laboratory, New Mexico, a helium—xenon laser was directly pumped by fission fragments. The obtained laser wavelength was 3.5 μm. A group of researchers at the Sandia Corporation in Albuquerque, New Mexico, was successful in energizing a carbon monoxide laser by fission fragments at wavelengths in the 5-μm band. At the University of Illinois lasing was achieved at wavelengths of 8629 A and 9393 A in a neon—nitrogen mixture. A program of gaseous core reactor research is underway with experiments being conducted at the Los Alamos Scientific Laboratory in New Mexico, USA. The program utilizes a beryllium moderator-reflector, forming a cylindrical cavity of 1 m diameter and 1 m length. This system and associated control system hardware, uses components from the previous ROVER nuclear rocket program. Critical mass, control swing and the effects of poison were measured by simulating enriched uranium hexafluoride fuel with uranium foils, which were placed in homogenous and inhomogeneous distributions in the cavity. Critical mass was determined at about 6 kg 93% enriched 235 uranium. A uranium hexafluoride canister system was built for safe operation in the reactor cavity and for physics measurements and observations at nuclear criticality.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 39724, 39958

38789 (AED-Conf—78-023-004) **Safety analyses for high-temperature reactors.** Mueller, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 32p. (In German). (CONF-780272—3). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Meeting on reactor engineering and nuclear power supply; Essen, F.R. Germany (27 Feb 1978).

The safety evaluation of HTRs may be based on the three methods presented: The licensing procedure, the probabilistic risk analysis, and the damage extent analysis. Thereby all safety aspects - from normal operation to the extreme (hypothetical) accidents - of the HTR are covered. The analyses within the licensing procedure of the HTR-1160 have shown that for normal operation and for the design basis accidents the radiation exposures remain clearly below the maximum permissible levels as prescribed by the radiation protection ordinance, so that no real hazard for the population will arise from them.

38790 (ANL—78-103) **Analysis of nonlinear fluid structure interaction transient in fast reactors.** Wang, C.Y. (Argonne National Lab., IL (USA)). Nov 1978. Contract W-31-109-ENG-38. 60p. Dep. NTIS, PC A04/MF A01.

A generalized Eulerian method is described for analyzing the fluid transients and the structural response in nuclear reactors under the postulated accident conditions. The phenomena considered are the wave propagation, slug impact, sodium spillage, bubble migration, and the fluid-structure interaction. The basic equations and numerical formulation are presented in detail. Sample calculations are given to illustrate the analysis. It is shown from the results that the implicit, iterative method used is unconditionally stable and is especially suitable for problems involving large material distortions.

38791 (BNL-NUREG—25714) **Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries.** Greene, G.A.; Jones, O.C. Jr.; Abuaf, N.; Schwarz, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790602—9). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Accident analysis of an HCDA in an LMFBR often involves consideration and calculation of thermal hydraulic events related to boiling pools of fuel and steel mixtures in the disrupted core, as well as the subsequent motion of these two-phase mixtures out of the core. In many cases, the thermal-hydraulic state of the boiling fuel-steel or fuel pool may determine the initial or boundary conditions for subsequent calculations. Calculations of boundary heat losses are directly dependent on knowledge of the local and pool-average void fraction, and assessment of models to predict the average void fraction depends on the availability of these experimental data. Experiments have been performed to determine the distribution of boundary heat losses from volume-heated boiling pools and the pool-averaged void fraction.

38792 (CEA-CONF—3999) **Application of the FLIRA code to fit ERSEC experiments.** Raymond, P.; L'Heriteau, J.P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Eau). 1977. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The FLIRA code was developed to calculate the maximum cladding temperature reached in the course of an accidental LOCA during reflooding of a water reactor. This code calculates the quench front progress. Its aim is to establish a model describing all the elementary mechanism involved in the reflooding phenomenon. This paper is devoted to the qualification of the FLIRA thermohydraulical model with help of ERSEC experiments performed with a tube (bottom reflooding). The model takes in account the seven following flow patterns. Four flow patterns occur when the wall is in contact with the liquid phase, upstream from the quenching front. And three flow patterns occur when the wall is in contact with the vapor phase, downstream from the quenching front.

38793 (CEA-CONF—4035) **Study of the effect of hard projectiles impacting reinforced concrete walls.** Berriaud, C.; Sokolovsky, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Etudes Mecaniques et Thermiques). 1977. 5p. (In French). (CONF-7710149—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 6. ASTE scientific and technical meeting; Paris, France (26 Oct 1977).

Among the risks examined in the framework of nuclear safety in France, quite unlikely events are examined as constituting a safety cover. This type of event includes the possible impact of aircrafts, or rotor splinters. Research on the limit strength of a wall under the impact of a hard projectile presently gives incentive results. First, a good agreement appears between works performed in parallel directions by EDF and CEA. Secondly, the special field of aerial projectiles is much better known as it was with previous formulations. Third, such research highly contributes to the knowledge of the mechanical strength of reinforced concrete structures.

38794 (CONF-790340—1) **Development of in-vessel reflood instrumentation at ORNL.** Eads, B.G.; Hardy, J.E.; Herskovitz, M.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

From Meeting of the Japanese nuclear society; Osaka, Japan (26 Mar 1979).

A program under the sponsorship of the United States Nuclear Regulatory Commission was intiated at the Oak Ridge National Laboratory (ORNL) in late 1977. The program, Advanced Instrumentation for Reflood Studies (AIRS), is charged with developing instrumentation for measurement of in-vessel fluid phenomena in pressurized water reactor reflood facilities. The goal of the ORNL program is to develop techniques and systems for measuring fluid flow in-core, deentrainment in the upper plenum and liquid fallback from the upper plenum into the core. A large portion of the development at ORNL is devoted to the impedance probes for measurement of two-phase flow velocities and void fractions. Film probe development at ORNL is limited to adapting the present techniques to the environment of a reflood facility. As the development progresses on all the measurement techniques, ORNL will fabricate and supply instrument systems to the reflood facilities included in the 2D/3D Program.

38795 (CONF-790423—3) **Multidimensional analysis based on a two-fluid model of fluid flow in a component of the LOFT system during a loss of coolant experiment.** Demmie, P.N. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 46p. Dep. NTIS, PC A03/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

A computer analysis of fluid flow in the Loss-of-Fluid Test (LOFT) cold leg blowdown pipe during a Loss-of-Coolant Experiment (LOCE) was performed using the computer program K-FIX/MOD1. This analysis constitutes the first application of a two-fluid model to fluid flow in a component of the LOFT system. The purpose of this analysis was to evaluate the capability of K-FIX/MOD1 to obtain theoretical fluid quantity distributions in the blowdown pipe during a LOCE for possible application to the analysis of LOFT experimental data, the determination of mass flow, or the development of data reduction models. A rectangular section of a portion of the blowdown pipe containing measurement Station BL-1 was modeled with fluid inflow from the upper annulus and fluid outflow from this portion of the blowdown pipe represented by time-dependent boundary conditions. Fluid quantities were calculated during a simulation of the first 26 seconds of LOCE L1-4.

38796 (CONF-790602—2) **Fuel rod behavior in a nine-rod bundle tested in film boiling.** Kerwin, D.K.; Hobbins, R.R.; Wehner, A.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 26 Jan 1979. Contract EY-76-C-06-1570. 5p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Effects of film boiling on fuel rod behavior determined from posttest examination of the first nine-rod bundle test (Test PCM-5) conducted in the Power Burst Facility (PBF) are presented. The power-cooling-mismatch test was designed primarily to investigate the film boiling behavior of a fuel rod surrounded by other rods in film boiling, i.e., a center rod in an environment believed to be representative of that of a power reactor rod during a period of overpower or low flow operation. Secondary objectives were to investigate possible rod-to-rod film boiling propagation, and rod-to-rod failure propagation; and to provide baseline data on operation and response of bundles for future PBF bundle tests.

38797 (CONF-790602—3) **Behavior of a failed fuel rod during film boiling operation.** Cook, B.A.; Hobbins, R.R.; Sparks, D.T. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

A single rod power-coolant-mismatch test (Test PCM-1) was conducted in the Power Burst Facility to evaluate the behavior of a pressurized water reactor (PWR)-type fuel rod subjected to film boiling operation at high power for a time exceeding that resulting in rod failure. The mechanisms of rod failure, the test rod response following failure, and the consequences of operation with a large molten fuel radius following fuel rod failure were investigated through destructive and nondestructive examination.

38798 (ESG-DOE—13254) **Annual technical progress report: reactor safety, Government fiscal year 1978.** (Atomics International

Div., Canoga Park, CA (USA)). 31 Dec 1978. Contract EY-76-C-03-0824-028. 45p. Dep. NTIS, PC A03/MF A01.

Progress in LMFBR safety studies on accident debris behavior is reported under the following subtask titles: high-temperature-concentration aerosols, large-scale molten fuel tests, sodium release tests, and risk analysis.

38799 (GA-A—14546) **One-fifth scale full-array test report. Final report.** Rakowski, J.E.; Olsen, B.E. (General Atomic Co., San Diego, CA (USA)). Dec 1978. Contract EY-76-C-03-0167-065. 77p. Dep. NTIS, PC A05/MF A01.

A series of horizontal uniaxial seismic tests were performed on a one-fifth scale model of a 3000-MW(t) HTGR reactor core. The purpose was to determine the core characteristic behavior in terms of displacement and frequency and to obtain specific core parameter data such as fuel element and reflector block impact velocities and forces and lateral support (spring pack) forces. These data were obtained for validating analytical models used in the prediction of HTGR core design loads. The test rig was excited in two directions, across-the-flats of the hexagonal core elements and across-the-corners. Both sinusoidal sweep and dwell type excitations were employed and also several simulated earthquakes representing different soil conditions. Two different lateral support stiffnesses representing a soft and a combined soft and hard stop design were also tested. This report presents the overall description of the tests conducted including test hardware, modeling, instrumentation, and test plan. The detailed test results and conclusions are published elsewhere.

38800 (GEFR—00415) **In-vessel core debris coolability for large breeder reactors.** Yang, H.K.; Gluekler, E.L. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 31 Oct 1978. Contract EY-76-C-03-0893-032. 64p. AT.

Work is in progress to evaluate the ability of inherent structural barriers and natural processes to mitigate the consequences of extremely low probability events which could involve meltdown of a portion of the reactor core. In this report, an assessment of the coolability of core debris within the primary system boundary of large breeder reactors is presented. Since the state and configuration of fuel after neutronic shutdown by relocation from the core region is uncertain, the coolability limits were determined for debris in the form of small fragmented particles, as well as solid or molten layers. To assess the coolability of fragmented particles, it was necessary to extend existing analytical models for particle bed dryout to include the effects of heat removal from the bottom of the particle layer, and sodium subcooling. At 1000 seconds after neutronic shutdown, the maximum volume fraction of core fuel that can be cooled as fragmented particles was predicted to be on the order of 5%. A flat retention plate located underneath the core support structure would improve the particle coolability limit to volume fractions between 50 and 100% depending on the design configuration. The analysis of solid and molten layers indicated that dryout and remelting of debris particle layers do not necessarily lead to debris penetration through the primary system boundary, if the following conditions are met: (a) heat must be removed from the lower surface of the structure retaining the debris by sodium natural convection, or (b) the structure must be able to withstand surface temperatures close to its melting point. Otherwise, the coolability limit for solid and liquid layers was found to be on the order of 0.25 to 0.7% of the core volume, depending on the final debris configuration and the boundary conditions assumed.

38801 (GRS-F—54) **List of reports on reactor safety research by BMFT, USNRC, EPRI and JSTA. Period under review: 1st January until 31st March 1978. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). May 1978. 37p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

This list reviews reports from the Federal Republic of Germany, from the United States of America and from Japan concerning special problems in the field of Reactor Safety Research. According to the cooperation of the Bundesminister fuer Forschung und Technologie (BMFT) with the United States Regulatory Commisssion (USNRC), the Electric Power Research Institute (EPRI), and the Japan Science and Technology Agency (JSTA) these reports are available in the Gesellschaft fuer Reaktorsicherheit. The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Program of BMFT, reporting organisation. The list of reports appears quarterly. Requests for reports should be addressed to GRS, Forschungsbereuung. Contractual view points have to be considered for the distribution of the reports.

38802 (INIS-mf—4426, pp V.1-11) **Technical aspects for PWR safety experiments with single rods and rod bundles in BR2 Mol.** Gaertner, M. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)); Fiege, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Hebel, W. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Krawczynski, S. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

A preliminary assessment has been prepared to resolve fundamental questions and to define the requirements of the irradiation tests to produce LOCA-typical fuel rod temperatures under safe operation conditions. The coolant circuit of the irradiation equipment for the simulated LOCA conditions are described as well as the design, construction and instrumentation of the fuel rods. The tentative test parameters and the irradiation program are presented.

38803 (INIS-mf—4426, pp II.1-13) **In-pile investigation of local cooling disturbance in LMFBR's (Mol 7C).** Kramer, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung); Vanmassenhove, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978.

From BR2 reactor review meeting; Mol, Belgium (1 Jun 1978).

The main results of the MOL7C investigation program aimed at determination of consequences of local cooling disturbances in fuel pin bundles up to pin destruction are presented. The objectives of the program, the description of the test facility, a special sodium loop in the BR2-reactor, the performance of the experiments and the conclusions are described.

38804 (INIS-mf—4492) **Structural dynamic analysis of BWR MARK II plant under SRV blowdown oscillation.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. Dep. NTIS (US Sales Only), PC A02/MF A01.

This paper describes investigations conducted for the determination of SRV blowdown effects on structures, equipment and piping systems. The plant selected for this investigation has a combination structural arrangement which combines the Reactor, Auxiliary, Control, Fuel Handling, radwaste and dissel building into one nearly square shaped building with the primary steel containment and its concrete shield structure located at center of the common foundation mat. This combination building is reasonably symmetrical about both the N-S and the E-W axes and therefore could be treated as such to reduce analysis effort in the mathematical modeling and response calculations. Finite element techniques are used for the structural response investigations. The mathematical model consists of membrane and bending elements representing one half of the combination building resting on series of springs simulating the elastic half space of soil medium underneath the structure. The damping behavior of the structural system has been carefully determined with the assitance of two other studies involving the soil-structure interaction analyses. The mathematical model is then subjected to the SRV blowdown loads in the digitized form to determine structural responses at critical locations. In-structure response spectrum at selected locations are also generated. The results of these investigations are then used to examine the capabilities of other important items such as the reactor pressure vessel, the reactor internals and the steel containment under the influence of the SRV blowdown load simultaneously with other loads which can be reasonably postulated to occur.

38805 (INIS-mf—4506, pp v) **Assessment of the integrity of PWR pressure vessels. A U.K. study group report.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

As part of the discussions held in 1973/4 over the choice of reactor system for the next stage of Britain's nuclear power programme, a Study Group of experts, chaired by Dr W. Marshall (the Member for Research, U.K. Atomic Energy Authority) set out to review the factors determining the integrity of LWR pressure vessels. The resulting report was sent to the U.K. Chief Inspector of Nuclear Installations in June, 1976, who agreed that a summary document - 'An Assessment of the Integrity of PWR Vessels', Report of a Study Group under the Chairmanship of Dr. W. Marshall, CBE, FRS, published by U.K. Atomic Energy Authority, Charles II Street, London. 1st October 1976 - should be prepared and published as an aid to public understanding. This document reviewed the material properties and their variation, detailed the various reactor transient conditions and assessed a typical design against the possbilities of ductile and non-ductile failure. Critical crack sizes were assessed for all design conditions and special consideration was given to such reactor fault conditions as loss of coolant and steam-line break. A careful assessment was made of the rate of crack growth to be expected in service due to fatigue and corrosion effects. The role of the cold hydro pressure test iin preventing vessels entering service with significant defects was discussed.

38806 (INIS-mf—4506, pp v) **Heavy-section steel technology program intermediate-scale pressure vessel tests.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Eight intentionally flawed thick-walled pressure vessels of ASTM A508 class 2 forging steel or A533, grade B, class 1 steel plate have been pressurized to fracture or leak. Tests of these vessels (990 mm OD, 152 mm wall thickness) permitted the study of fracture behavior of structures under stress states not attainable with conventional testing machines. The test section thickness was chosen in order to provide a test configuration that was essentially full-scale relative to BWR and PWR pressure vessels. Experimental results were used to evaluate and improve methods of fracture analysis that could be used in predicting failure conditions of reactor type pressure vessels. The test sections of the vessels were of two types: cylindrical and cylindrical with an intersecting nozzle. In every case, one or more sharp surface flaws were introduced in an axial-radial plane. Flaws were located in the outside and inside cylindrical regions, in weld metal and base metal, and at the inside nozzle corners. Test temperatures ranged from 0°C to 91°C, covering a range of toughness from transition to static and dynamic upper shelf. The first eight tests were conducted with hydraulic pressurization, which was presumed to adequately sustain loadings for the study of crack initiation. One vessel that leaked without fracturing was repaired and retested pneumatically with an identical flaw to determine whether a sustained and more compliant loading would alter the mode of failure.

38807 (JAERI-M—7453) **Preliminary experiment on crack propagation in zircaloy-cladding. Failure behavior of zircaloy-cladding, (1).** Fujita, M.; Kikuchi, A. (Japan Atomic Energy Research Inst., Tokyo). Dec 1977. 14p. (In Japanese). Dep. NTIS (US Sales Only), PC A02/MF A01.

Study of SCC the zircaloy cladding is one of the most important subjects in safety study of LWR fuel. As the preliminary study of crack propagation under SCC conditions, crack propagation behaviour of zircaloy-2 cladding was investigated by applying impact load to the inner surface at room temperature. With a notch on inner surface of the cladding, influence of shape of the notch on the crack propagation behaviour was observed. Formation of a wrinkly zone of delta hape (named "Delta-Wrinkly-Zone," abbreviated to DW zone) was observed on the end face of the cladding. Appearance and the number of wrinkles in DW zone were found to have correlation with the extent of loading as well as initiation and propagation of the crack. It was also found that tiny cracks near the X-mark made on outer surface of the cladding at nearly the same time as the formation of DW zone, were deeper toward the cross point of X-mark. SEM fractography at cracks revealed dimples, indicating the fracture to be ductile one. Microhardness measurement of the DW zone showed that there was no much difference in hardness between DW zone and the matrix.

38808 (JAERI-M—7503) **Fuel pin behavior during UO_2 pellet melting.** Yanagisawa, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1978. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Fuel pin behavior with heat rating up to UO_2 melting was investigated by means of power cycling capsule of JMTR (Japan Materials Testing Reactor). The fuel pin was subjected to power irradiation examination for metallographic study. Results are: (1) UO_2 pellet melting occurred at 630 W/cm and the molten UO_2 spread cylindrically in one-third the bulk of specimen. (2) A typical cross sectional ceramography revealed that grain boundaries were not observed at the central part and non-equiaxial and equiaxial grains were observed at middle and outer parts. (3) Pores were mostly on the grain boundaries, few in the grains. (4) Cracks in the pellet were transgranular.

38809 (Juel—1490) **Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures.** Schenk, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). May 1978. 142p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

Thesis.

A post irradiation annealing test apparature was constructed for the measurement of fission gas release at temperatures similar to those to be reached in a HTR during a hypothetical accident. From examinations with existing apparatures up to temperatures of 1800°C results were available about the load capacity of coated particles as well as knowledges about fission gas release and defect behaviour. These results were used to plan a series of annealing tests with spherical fuel elements up to 2500°C. It could be shown that the $(U,Th)O_2$-particles with high burnup will fail during maximum core heat up of a HTR only after some hours at temperatures above 2400°C.

38810 (KFA-AKI-IB—1/77) **Nuclear energy from the point of view of the population. Analysis of attitudes and motives.** Renn, O. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Arbeitsgruppe Kernenergie-Information). Dec 1977. 200p. (In German). Dep. NTIS (US Sales Only), PC A11/MF A01.

The present study refers mainly to an empirical attitude investigation carried out in 1975 and 1976 in a suburb of Cologne. In order to remain up-to-date, new research results have been included in the analysis. The aim of the publication at hand is to deal with the nuclear controversy in its sociological and social-psychological dimensions, and also to elucidate motives and reasons behind the protests against nuclear energy. The report has been written for sociologists, nuclear engineers and scientists, journalists, political decision-finding authorities and interested laymen alike, and is to offer a general orientation in contradicting statements as regards the stance of the population. The central statement of this very detailed investigation is, that the population has a mainly positive attitude towards the construction of a nuclear power plant - even then when antipathy and uneasiness towards a new energy source prevent emotional identification.

38811 (NUREG—0090(Vol.1)(No.4)) **Report to Congress on abnormal occurrences, October—December 1978.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Management and Program Analysis). 31 Jan 1979. 42p. NTIS, PC A03/MF A01.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. The report, the fifteenth in the series, covers the period from October 1 to December 31, 1978. The following incidents or events, including those submitted by the Agreement States, in that time period were determined by the Commission to be significant and reportable: (1) There was one abnormal occurrence at the 70 nuclear power plants licensed to operate. The event involved a loss of containment integrity at two pressurized water reactors. (2) There were no abnormal occurrences at fuel cycle facilities (other than nuclear power plants). (3) There were no abnormal occurrences at other licensee facilities. (4) There were two abnormal occurrences reported by the Agreement States. One event involved a radiation overexposure of a radiographer's assistant. The other involved transportation of a package with radiation levels in excess of limits. The report also contains information updating previously reported abnormal occurrences.

38812 (NUREG/CR—0513) **Reactor safety research programs. Quarterly progress report, July 1—September 30, 1978.** Agrawal, A.K.; Cerbone, R.J.; Jones, O.C. Jr.; Reich, M.; Sastre, C.; Schweitzer, D.G.; van Rooyen, D.; Wulff, W. (Brookhaven National Lab., Upton, NY (USA)). Nov 1978. Contract EY-76-C-02-0016. 223p. (BNL-NUREG—50931). Dep. NTIS, PC A10/MF A01.

The report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the USNRC Reactor Safety Research Division. The projects reported include the following: Gas Reactor Safety Evaluation, THOR Code Development, Code Review, SSC Code Development, LMFBR and LWR Safety Experiments, Fast Reactor Safety Code Validation, Stress Corrosion Cracking PWR Steam Generator Tubing, and Technical Coordination of Structural Integrity.

38813 (NUREG/CR—0561) **Scaling and constitutive relationships in downcomer modeling.** Daly, B.J.; Harlow, F.H. (Los Alamos Scientific Lab., NM (USA)). Dec 1978. Contract W-7405-ENG-36. 27p. (LA—7610). Dep. NTIS, PC A03/MF A01.

Constitutive relationships to describe mass and momentum exchange in multiphase flow in a pressurized water reactor downcomer are presented. Momentum exchange between the phases is described by the product of the flux of momentum available for exchange and the effective area for interaction. The exchange of mass through condensation is assumed to occur along a distinct condensation boundary separating steam at saturation temperature from water in which the temperature falls off roughly linearly with distance from the boundary. Because of the abundance of nucleation sites in a typical churning flow in a downcomer, we propose an equilibrium evaporation process that produces sufficient steam per unit time to keep the water perpetually cooled to the saturation temperature. The transport equations, constitutive models, and boundary conditions used in the K-TIF numerical method are nondimensionalized to obtain scaling relationships for two-phase flow in the downcomer. The results indicate that, subject to idealized thermodynamic and hydraulic constraints, exact mathematical scaling can be achieved. Experiments are proposed to isolate the effects of parameters that contribute to mass, momentum, and energy exchange between the phases.

38814 (NUREG/CR—0617) **Two phase interactions in countercurrent flow: studies of the flooding mechanism. Annual report, No-**

vember 1975—October 1977. Dukler, A.E.; Smith, L. (Houston Univ., TX (USA). Dept. of Chemical Engineering). Dec 1977. 107p. NTIS, PC A06/MF A01.

This study was undertaken to develop an understanding of the mechanisms of gas—liquid interaction in counter and upflow as well as the mechanism for flow reversal at the flooding point. Measurements have been made of the distribution of liquid between up and downflow in the flooding region and of pressure gradient, entrainment, and film thickness under conditions of counterflow, upflow, and across the flooding region. The data are interpreted in terms of existing and new models for the flooding process.

38815 (NUREG/CR—0651) **Status report on ECC penetration scaling research.** Collier, R.P.; Flanigan, L.J.; Bishop, T.A.; Liu, J.S.K. (Battelle Columbus Labs., OH (USA)). Feb 1979. 71p. (BMI—2019). Dep. NTIS, PC A05/MF A01.

A summary is presented of results of ECC penetration research carried out as part of the Steam—Water Mixing Program at Battelle Columbus Laboratories. It also includes a discussion of scaling of small scale ECC penetration and condensation results to large facilities. The summary includes a discussion of ECC penetration test results, and the correlation developed from those data, discussion of hot wall effects, discussion of cold leg steam effects, and a discussion of transient steam flow effects. The discussion of ECC penetration scaling includes a review of results from experiments in tubes of various diameters, comparison of data from experiments in reactor-like geometries at different scales, a statistical evaluation of the penetration correlation developed from those data and description of an improved scaling parameter.

38816 (NUREG/CR—0697) **Fission product transport analysis. Quarterly progress report, January 1—March 31, 1978.** Gieseke, J.A.; Baybutt, P.; Jordan, H.; Jung, R.G. (Battelle Columbus Labs., OH (USA)). Feb 1979. 11p. (BMI—2022). NTIS, PC A02/MF A01.

Technical efforts during the reporting period were concerned primarily with developing the TRAP-MELT code by addition of specific mechanisms describing particle transport and deposition, and by continuing the preparation of thermal-hydraulic data for use with the code. Particle deposition mechanisms added to the TRAP-MELT code include deposition by thermophoresis and by diffusion and inertia from laminar and turbulent steam flows. Efforts concerned with describing thermal-hydraulic conditions have led to specification of data for a specific assumed accident sequence, AB with a cold-leg break, that will be used as the reference case during completion of the code development efforts.

38817 (NUREG/CR—0698) **Fission product transport analysis. Quarterly progress report, April 1—June 30, 1978.** Gieseke, J.A.; Baybutt, P.; Jordan, H.; Jung, R.G. (Battelle Columbus Labs., OH (USA)). Feb 1979. 10p. (BMI—2023). NTIS, PC A02/MF A01.

Technical progress during the reporting period has been concerned primarily with continued development of the TRAP-MELT computer code, specification of conditions and code input for meltdown accidents, and initiation of efforts to provide functional design specifications for a fission product transport test facility. The code development efforts were concerned primarily with incorporating the mechanisms into the TRAP-MELT code that allow for particle growth by agglomeration, and adding expressions to give steam viscosity and density up to high temperatures and pressures. To provide a set of conditions for use in developing the code, the needed input for a radionuclide source term was specified by combining best estimate core release fractions with calculated inventories. Technical efforts and results in these areas are discussed individually.

38818 (NUREG/CR—0702) **Two-phase flow phenomena in nuclear reactor technology. Quarterly progress report No. 10, September—November 1978.** Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Dec 1978. 97p. NTIS, PC A06/MF A01.

Research progress in the following tasks is described: two-phase flow instrumentation, phase separation and distribution phenomena, and BWR ECC parallel channel effects.

38819 (NUREG/CR—0716) **High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research quarterly progress report, October 1—December 31, 1978.** Ball, S.J.; Cleveland, J.C.; Conklin, J.C.; Lister, D.G. (Oak Ridge National Lab., TN (USA)). 3 Apr 1979. Contract W-7405-ENG-26. 22p. (ORNL/NUREG/TM—314). Dep. NTIS, PC A02/MF A01.

Further development of the ORECA code was done based on analyses of Fort St. Vrain (FSV) reactor test data. Work also continued on upgrading the ORTAP, BLAST, and FLODIS codes. Preliminary reverse-flow plume experiments for investigating the FSV upper plenum cover plate heating phenomenon were continued. Further assistance was given to NRC on FSV questions relating to their 100% power license application and the oscillation problem.

38820 (NUREG/CR—0740) **1978 annual report: aerosol characterization from a simulated HCDA.** Zanotelli, W.A.; Miller, G.D.; Johnson, E.W. (Mound Facility, Miamisburg, OH (USA)). Mar 1979. 33p. (MLM—2597). NTIS, PC A03/MF A01.

Simulated environmental conditions modelling the HCDA on a reduced scale have provided the following information: Aerosols resulting from the condensation of gaseous constitutents are generally spherical, small in diameter (0.01 to 0.25 μm), and branched chain-like structures. Electron diffraction analyses have identified actinide dioxides, the constituents of stainless steel, and various sodium actinates (uranates and zirconates). Some superstoichiometric oxides ($UO_{2.25}$ and U_3O_8) were noted also. X-ray analyses were not sensitive enough to verify presence of sodium uranates or plutonates. Electron diffraction of the plutonia-doped system should verify these components in this mixed-actinide system. Reaction products are kinetically controlled during cool-down rather than based upon equilibrium thermodynamics.

38821 (NUREG/CR—0746) **Effects of torus wall flexibility on forces in the Mark I boiling water reactor pressure suppression system. Final report.** Lu, S.C.; Holman, G.S.; McCauley, E.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1978. Contract W-7405-ENG-48. 80p. (UCRL—52624). Dep. NTIS, PC A05/MF A01.

The FY78 results are summarized of a program to investigate, through analytical models, the effects of wall flexibility on hydrodynamically induced loads in the torus-shaped pressure suppression chamber of a Mark I boiling water reactor, both in the event of a safety relief valve (SRV) discharge and a hypothetical loss-of-coolant accident (LOCA). Two-dimensional and three-dimensional analytical models for these two events were created by using the Monticello nuclear plant's geometry and finite element computer codes. Initial two-dimensional results were documented in the FY77 report (Lawrence Livermore Laboratory, UCRL—52506); those two-dimensional results are extended here by varying the pulse amplitudes and conducting nonlinear analyses for comparison with the linear analyses. Finally, three-dimensional analyses are conducted for the SRV discharge and LOCA chug problems.

38822 (ORNL—5486) **Solid State Division. Progress report for period ending September 30, 1978.** Wilkinson, M.K.; Young, F.W. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 267p. Dep. NTIS, PC A12/MF A01.

Research is reported on fracture mechanics analyses and investigations, effect of high temperature primary reactor water on subcritical crack growth of reactor vessel steels, investigations of irradiated materials, pressure vessel investigations, and thermal shock investigations. (FS)

38823 (SAND—78-0261C) **Steam explosion triggering and efficiency studies.** Buxton, L.D.; Nelson, L.S.; Benedick, W.B. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 3p. (CONF-790429—1). Dep. NTIS, PC A02/MF A01.

From 4. specialist meeting on fuel-coolant interaction in nuclear reactor safety; Bournemouth, UK (2 Apr 1979).

Laboratory experiments on the thermal interaction of simulated light water reactor (LWR) fuel melts and water are summarized. Their purpose was to investigate the possibility of steam explosions occurring for a range of hypothetical accident conditions. Pressure, temperature, hot liquid motion and cold liquid motion were monitored during the experiments.

38824 (SAND—78-2074C) **Consequence model of the German reactor safety study.** Bayer, A.; Aldrich, D.; Burkart, K.; Horsch, F.; Hubschmann, W.; Schueckler, M.; Vogt, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-790519—1). Dep. NTIS, PC A02/MF A01.

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

The consequency model developed for phase A of the German Reactor Safety Study (RSS) is similar in many respects to its counterpart in WASH-1400. As in that previous study, the model describes the atmosphere dispersion and transport of radioactive material released from the containment during a postulated reactor accident, and predicts its interaction with and influence on man. Differences do exist between the two models however, for the following reasons: (1) to more adequately reflect central European conditions, (2) to include improved submodels, and (3) to apply additional data and knowledge that have become available since publication of WASH-1400. The consequence model as used in phase A of the German RSS is described, highlighting differences between it and the U.S. model.

38825 (TFBP-TR—279) **PBF-LOCA single rod tests program experiment specification document.** Yackle, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1978. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

The purpose of this document is to define the fuel and test train requirements for the LOCA Single Rod Tests which comprise a major portion of the LOCA test program. This document provides the test hardware requirements for all the LOCA single rod tests. Upon completion of the reactor physics calculations, the flow shroud thickness for all of the unirradiated test rods will be specified. The single rod tests will consist of four separately shrouded fuel rods of Saxton design. Two rods will have been previously irradiated and two rods are unirradiated. One unirradiated and one irradiated rod will be backfilled with helium to a pressure typical of fresh PWR fuel, and the other rods will be backfilled to a cold pressure typical of a fuel rod at the end of operational life.

38826 (UCB/EERC—79/08) **Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping.** Lee, M.C.; Penzien, J.; Chopra, A.K.; Suzuki, S.; Powell, G.H.; Wilson, E.L.; Clough, R.W.; Row, D.G. (California Univ., Berkeley (USA). Coll. of Engineering). Feb 1979. Contract EY-76-S-03-0034-269. 205p. Dep. NTIS, PC A10/MF A01.

The results of an investigation into the desirability of using solid-state nonlinear hysteretic energy absorbing restrainers as the supporting elements for nuclear power plant piping systems are presented. These results have been generated for three cases representing simple piping systems, namely, (1) linear pipes with linear restrainers, (2) linear pipes with elasto-perfectly plastic restrainers, and (3) linear pipes with Ramberg-Osgood type restrainers. Realistic seismic response produced at typical support points within a power plant main structure is used as the input excitation to the support restrainers. Dynamic time-histories of response have been determined for each case over prescribed ranges of the critical parameters and the significant results have been correlated. The results of the investigation show that nonlinear energy absorbing restrainers can be very effective in reducing seismic forces in piping systems, without excessive yielding, provided they are properly designed. Restrainers of the Ramberg-Osgood type have been found to be very effective when the characteristic parameters are properly controlled. Based on the results of the overall investigation, it is concluded that nonlinear hysteretic energy absorbing restrainers can improve the seismic performance of nuclear power plant piping systems resulting in cost savings and enhanced safety.

38827 (UCRL—52708) **LLL field test systems division support to the U.S. Nuclear Regulatory Commission. FY 1978 progress report.** Rumble, R.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

The Lawrence Livermore Laboratory (LLL) performed technical evaluations for the U.S. Nuclear Regulatory Commission, Division of Operating Reactors, as part of a continuing program. This report summarizes the work done in FY 78 and provides references to detailed reports. Evaluations were performed on Selected Electrical, Instrumentation, and Control System Issues in existing reactors. The Select Issues investigated include reactor coolant system overpressurization protection, flooding of plant safety-related equipment, anticipated transients without scram, and local power range monitor drift. Short-term technical assistance was also provided on the problem of cable leakage during LOCAs. In support of the Systematic Evaluation Program, LLL also began evaluating the plant protection systems in the 11 oldest operating power reactors in light of selected current criteria.

38828 Aims of a measurement program to detect unplanned radioactive discharges from nuclear power stations equipped with light-water reactors, and requirements for the measuring instruments. Albrecht, L.; Muenchow, W.; Rumpf, J. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). pp 99-105 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The instrumentation for measuring radiation at a nuclear power station serves to assess the radiation situation in the facility and in its environment as well as to monitor technological media. If an accident occurs, the instrumentation designed for normal operation is often unable to provide a sufficient assessment of the radiation situation. Specific measuring techniques with an extended scope are needed. Detailed methods are proposed suitable for carrying out the measurements required in the event of an accident.

38829 Modeling vertical loads in pools resulting from fluid injection. Lai, W.; McCauley, E.W. (Univ. of California, Livermore). Contract 189A:A-118-6. pp 113-121 of Fluid transients and acoustics in the power industry. Papadakis, C.; Scarton, H. (ed.). New York, NY; American Society of Mechanical Engineers (1978).

Table-top model experiments were performed to investigate pressure suppression pool dynamics effects due to a postulated loss-of-coolant accident (LOCA) for the Peachbottom Mark I boiling water reactor containment system. The results guided conduct of experiments in the 1/5-scale facility and provided new insight into the vertical load function (VLF). Model experiments show an oscillatory VLF with the download typically double-spiked followed by a more gradual sinusoidal upload. The load function contains a high frequency oscillation superimposed on a low frequency one; evidence from measurements indicates that the oscillations are initiated by fluid dynamics phenomena. Maximum download diminishes with initial downcomer fill level. When the downcomer is initially empty, the maximum download degenerates to a gradual sinusoidal shape. This leads to the possibility of an empirical model of the VLF consisting of damped low frequency and a higher frequency ($\sim$ 10 times the low frequency) sinusoidal components. As evidenced by the 25 air-water tests conducted with our 1/5-scale three-dimensional facility, the VLF measured from the table-top experiments accurately predicted the general characteristics of the VLF from larger, properly configured apparatus.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 38897

38830 (DOE/ET—0091) **Thermal and mechanical energy storage program, FY 1979: project summary data.** (Department of Energy, Washington, DC (USA)). Mar 1979. 184p. Dep. NTIS, PC A09/MF A01.

DOE's Division of Energy Storage Systems (STOR) is supporting a broad range of projects to conserve energy and to make possible shifting away from oil and natural gas by developing new and/or improved energy storage systems applicable to central power generation, dispersed power generating, solar and waste heat utilization, and vehicle propulsion. This summary report addresses categories on mechanical and magnetic energy storage, thermal and thermochemical energy storage, and chemical/hydrogen energy storage. Electrochemical energy storage is treated in a separate document. Summary reports for mechanical and magnetic energy storage are included for flywheels for vehicles, mechanical storage for solar energy, underground pumped hydroelectric, compressed air energy storage, and superconducting magnetic energy storage. Summary reports for thermal and thermochemical energy storage are included for low- and high-temperature thermal energy storage and thermochemical energy storage and transport. Summary reports for chemical/hydrogen energy systems are included for the production, storage, transport, and use of hydrogen and chemical storage other than hydrogen. The Technical and Economic Analysis Activity provides information needed to set and evaluate Energy Storage Program objectives and project summary data are given for this activity. Information on summary sheets includes project title, principal investigator, organization, project goals, project status,contract number and period, and funding level and source. (MCW)

MAGNETIC

38831 Superconductive energy storage for power systems. Peterson, H.A.; Boom, R.W. (to Wisconsin Alumni Research Foundation). US Patent 4,122,512. 24 Oct 1978. Filed date 2 Oct 1974. 12p.

Energy derived from an alternating current power system is stored in a superconducting magnet or inductor. The transfer of the energy is reversible so that the energy stored in the superconducting magnet can be returned to the alternating current power system. Generally, the energy is stored when surplus energy is available, due to low demand. The energy stored in the superconducting magnet may be returned to the power system when demand is high. High efficiency in the storage and return of the energy is achieved. A reversible converter is provided between the alternating current system and the superconducting magnet so that the magnet is supplied with direct current when energy is being stored. The converter may be adjusted so as to convert direct current into alternating current when it is desired to return the stored energy to the power system. The converter may comprise a rectifier-inverter system utilizing controlled rectifiers and a variable firinng angle controller which is adjustable to control the operating mode of the rectifier-inverter system. The controller may be adjusted so that the system functions as a rectifier unit to convert the alternating current to direct current for the storage of energy in the superconducting magnet. The controller may be adjusted to a different firing angle so that the system functions as an inverter to convert direct current from the magnet into alternating current which is returned to the power system. The energy storage system can have lower losses than systems of prior types, such as pumped hydro-storage systems.

The superconductive magnet system also has the ability to damp electro-mechanical oscillations in the power system.

38832 Design analysis of annular tunnels for superconductive energy storage using the finite element method. Fuh, G.F. Madison, WI; Univ. of Wisconsin (1978). 246p. University Microfilms Order No. 78-15,043.

Thesis (Ph. D.).

Superconductive magnets housed in large annular tunnels are an economically feasible alternative to pumped hydroelectric energy storage. Such magnets consist of solenoidal conductors, which, when charged, expand radially and contract axially. To avoid the destruction of the magnet structure, these loads are transferred to the tunnel walls by a series of struts. The magnetically induced loads act both radially and axially, inducing both normal and shear stresses along the wall surface. Based on the investigations conducted, it is concluded that stable tunnels can be designed for housing superconductive magnets in such crystalline rock as Montello granite.

PUMPED HYDRO

REFER ALSO TO CITATION(S) 39632

FLYWHEELS

38833 (AD-A—059736) **Development of composite flywheels for energy storage and gyroscopic controls. Interim report Jul 76-Apr 77.** Bagaria, W.J. (Naval Academy, Annapolis, MD (USA). Environmental Protection Research and Development Team). Mar 1977. 22p. NTIS PC A02/MF A01.

This report describes a research project to investigate the advantages, disadvantages and construction techniques of three composite flywheel designs. The three designs are based on fabricating the flywheels from unidirectional prepreg fiber/epoxy tape. The designs studied were: circumferential-wound, radial-wound, and radial-wrapped core. For each design, construction techniques and geometric design parameters, such as tape width, length, angle of wrap and flywheel diameter, were developed.

38834 (PB—284611) **A limited investigation into regenerative braking and energy storage for mass transit systems. Final report March-October 1977.** Eisenhaure, D.; O'Dea, S. (Draper (Charles Stark) Lab., Inc., Cambridge, MA (USA)). Mar 1978. Contract DOT/TSC-RA-77-1. 47p. NTIS PC A03/MF A01.

This study examines the technical and economic aspects of a regenerative braking/flywheel energy storage subway system. In order to define the analytical models accurately, it was necessary to gather data on the trains, rail network, schedules, and ancillary equipment. Data on projected costs of flywheels, motors, rails, and other equipment were also gathered for use in the economic analysis. During this data gathering phase, it was decided that the Massachusetts Bay Transportation Authority (MBTA) Red Line would be the source of the most representative and complete data. The problem was to determine what, if any, combination of energy storage devices and high conductivity rails would yield a subway system with a lower life cycle cost. The primary goal of the study was to compare the system costs of wayside storage with those of on-board storage. Using data provided by MBTA, power levels vs. time and rail losses were calculated and used to determine the sizing and location of energy storage units. From the amounts of energy storage required, the costs of the flywheels and i/o equipment were calculated. Utilizing these modules for load leveling was also considered. However, since the energy storage required for load leveling is much greater than that required for regenerative braking, a separate study is needed to examine this in detail.

38835 Variable inertia flywheel as an energy storage system. Ullman, D.G. Columbus, OH; Ohio State Univ. (1978). 216p. University Microfilms Order No. 78-12,395.

Thesis (Ph. D.).

A variable inertia flywheel system (VIF) was designed and fabricated. A fundamental purpose of the design was to verify the theoretical predictions and to evaluate the bac operating characteristics of the concept. A major conclusion drawn is that a fully controllable VIF, full control over the moment of inertia irrespective of the VIF state, is not practical as the efficiency obtained can be no better than a fixed inertia flywheel with an infinitely variable ratio transmission. However, a VIF with a fixed power recirculation results in a flywheel with a unique torque/angular rate characteristics. Whereas a fixed inertia flywheel is restricted to T/sub f/ = I/sub ωf/ a VIF can theoretically be formed such that the torque is related to any function of angular rate.

THERMAL

REFER ALSO TO CITATION(S) 38482, 38492, 38504, 38506, 38507, 38508, 38937

38836 (DOE/NASA/0038—79/1) **Active heat exchange system development for latent heat thermal energy storage.** Lefrois, R.T.; Knowles, G.R.; Mathur, A.K.; Budimir, J. (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Feb 1979. Contract EC-77-A-31-1034. 124p. (NASA-CR—159479; HI—79063). Dep. NTIS, PC A06/MF A01.

The report describes active heat exchange concepts for use with thermal energy storage systems in the temperature range of 250°C to 350°C, using the heat of fusion of molten salts for storing thermal energy. It identifies over 25 novel techniques for active heat exchange thermal energy storage systems. Salt mixtures that freeze and melt in appropriate ranges are identified and are evaluated for physico-chemical, economic, corrosive and safety characteristics. Eight active heat exchange concepts for heat transfer during solidification are conceived and conceptually designed for use with selected storage media. The concepts are analyzed for their scalability, maintenance, safety, technological development and costs. A model for estimating and scaling storage system costs is developed and is used for economic evaluation of salt mixtures and heat exchange concepts for a large scale application. The importance of comparing salts and heat exchange concepts on a total system cost basis, rather than the component cost basis alone, is pointed out. Comparison of these costs with current state-of-the-art systems should be avoided due to significant differences in developmental status. The heat exchange concepts were sized and compared for 6.5 MPa/281°C steam conditions and a 1000 MW(t) heat rate for six hours. A cost sensitivity analysis for other design conditions is also carried out. The study resulted in the selection of a shell and coated-tube heat exchanger concept and a direct contact-reflux boiler heat exchange concept. For the storage medium, a dilute eutectic mixture of 99 wt % $NaNO_3$ and 1 wt % NaOH is selected for use in experimenting with the selected heat exchanger concepts in subsequent tasks.

38837 (ORNL/TM—6701) **Low-Temperature Thermal Energy Storage Program. Annual progress report, October 1977—September 1978.** Brunton, G.D.; Eissenberg, D.M.; Kedl, R.J. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 103p. Dep. NTIS, PC A06/MF A01.

The Low-Temperature Thermal Energy Storage (LTTES) Program is part of a national effort to develop means for reducing United States dependence on oil and natural gas as primary energy sources. To this end, LTTES addresses the development of advanced sensible and latent heat storage technologies that permit substitution by solar or off-peak electrical energies or permit conservation by recovery and reuse of waste heat. Emphasis is on applying these technologies to heating and cooling of buildings. As the LTTES program continued to mature, a number of technologies were identified for development emphasis, including (1) seasonal storage of hot and cold water from waste or natural sources in aquifers, (2) short-term or daily storage of heat or coolness from solar or off-peak electrical sources in phase-change materials, and (3) recovery and reuse of rejected industrial heat through thermal storage. These areas have been further divided into three major and four minor activities; significant accomplishments are reported for each.

38838 (ORNL/TM—6936) **Low-Temperature Thermal Energy Storage Program. Progress report, October 1978—March 1979.** Eissenberg, D.M.; Hoffman, H.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

Use of low-temperature heat can result in significant conservation in building heating and cooling through replacing oil and gas with energy from alternate sources such as direct solar, environmental chill, waste heat, and off-peak electricity. Developing technologies for storing this heat for subsequent consumption is the responsibility of the ORNL Low-Temperature Thermal Energy Storage (LTTES) Program. The effort is focussed in three thrust areas: seasonal storage of hot/cold water principally in aquifers, short-term/diurnal storage for space conditioning principally in phase-change materials, and short-term storage of industrial waste heat. The first of these is receiving primary emphasis. The objective and status of projects in each of these areas is reviewed.

BATTERIES

38839 (BMVg-FBWT—78-20) **Experimental study of new electrochemical systems for military high-power applications.** Sprengel, D. (Bundesministerium der Verteidigung, Bonn (Germany, F.R.). Abt.

Wehrtechnik). 1978. 77p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

According to the aims of the study a series of electrochemical systems for the storage of energy were selected. The data of energy and power of these were determined. The system having the best chances in military high-power-applications was tested experimentally by building cells and charging and discharging those. The following systems are investigated: Al/KOH/H_2O_2, Mg/chloride solution/CuCl, Mg or Al/chloride solution/TCC or TCM, LiAl/LiCl, KCl/FeS or FeS_2, Na/β-Al_2O_3/S - and further systems comprising alkaline electrolyte, a metal and a gas-diffusion-electrode. The technical and economic data and the properties corresponding to application are compared; reference-system is the couple Zn/KOH/AgO. Building and testing of cells of the system LiAl/LiCl, KCl/FeS_2 leads to the conclusion that, after an adequate development phase, batteries of this system for military purpose can be produced having the following data: energy density 75 Wh/kg or 135 Wh/l, power density 150 W/kg or 180 W/l, cycle number more than 100, good storability.

38840 (N—77-74765) **Battery literature, search, bibliography and abstracts. Volume I.** (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1976. Contract NAS7-100. 157p.

A comprehensive bibliography of references has been compiled dealing with nickel-cadmium cells and related technology for aerospace applications. The bibliography consists of a list of approximately 2400 articles, papers, test reports, and books with abstracts. An extensive subject listing is provided with cross-referencing with an author index in this volume (Volume I).

38841 (N—77-74766) **Battery literature search, bibliography and abstracts. Volume II.** (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1976. Contract NAS7-100. 354p.

This comprehensive bibliography with abstracts, consisting of five volumes, was compiled to assist battery technologists to obtain information quickly on secondary aerospace battery cells and related technology. Most citations contain an accession number which refers to the computer searches of the Defense Documentation Center, National Technical Information Service, etc. This number can be used to obtain a copy of the publication from the appropriate file source.

38842 (N—77-74769) **Battery literature search, bibliography and abstracts. Volume V.** (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1976. Contract NAS7-100. 176p.

This is Volume V of a comprehensive bibliography with abstracts on secondary aerospace battery cells and related technology.

38843 **Summary transcript of IBMA annual convention, October 12—14, 1977.** Largo, FL; Independent Battery Manufacturers Association, Inc. (1977). 132p. (CONF-7710193—).

From 40. IBMA convention; Chicago, IL, USA (12 Oct 1977).

Much interest at this IBMA convention centered on maintenance-free batteries. Notable feaures of the meeting included a shelf-life symposium, OSHA regulations update, a discussion of plant standards, consideration of airborne lead and its filtration, comments on product liability, and a panel on maintenance-free batteries and their production. As usual, marketing information and association business are interspersed among the more technical papers. (RWR)

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 38986

38844 **Operational zinc chlorine battery based on a water store.** Carr, P.; Symons, P.C.; Aller, D.J. (to Energy Development Associates). US Patent 4,146,680. 27 Mar 1979. Filed date 15 Jun 1978. 6p.

A zinc—chlorine battery system is described in which chlorine gas evolved from the cell structure of the battery during charging of the battery is combined with a stored supply of water to form solid chlorine hydrate. During the discharge cycle of the battery, the chlorine hydrate is decomposed to replenish the chlorine content of the electrolyte. 1 figure.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 38849, 39247, 39248, 39596

38845 (AD-A—059295) **Nickel—zinc battery for aircraft and missile applications. Final report 14 Feb 75-14 Feb 78.** Brown, R.A. (Eagle-Picher Industries, Inc., Joplin, MO (USA). Couples Dept.). Apr 1978. Contract F33615-75-C-2004. 146p. NTIS PC A07/MF A01.

For aircraft applications, a nickel-zinc battery has been developed which exhibits an improvement in low-temperature/high-rate performance as compared to the standard nickel-cadmium aircraft battery (MS-24497-5). The nickel-zinc battery is the same size and weight as the nickel-cadmium battery, but is rated at 45 Ah capacity vs. 22 Ah for the nickel-cadmium. Cycle life of 200 cycles (20 amperes for 1 hour) have been demonstrated in a configuration capable of delivering 1000 ampere discharge at -20 F. Nickel-zinc batteries were also manufactured for remotely piloted vehicle (RPV) applications to compare to existing lead-acid and silver-zinc batteries. These vehicles require a limited number of cycles at a high energy density and are a logical application of the nickel-zinc system. For missile applications, a remotely activated nickel-zinc battery has been developed to compare to the standard remotely activated silver-zinc battery. Reductions in the amount of separator needed for wet stand capability allow the nickel-zinc battery to exhibit higher capacity than the silver-zinc battery at room temperature discharge.

38846 (N—78-31540) **Evaluation program for secondary spacecraft cells. Annual report.** Harkness, J.D. (Naval Weapons Support Center, Crane, IN (USA)). 1 Feb 1978. 285p. NTIS PC A13/MF A01.

The results of life cycle tests of secondary spacecraft cells are summarized. Cells consisted of seven sample classifications ranging from 3.0 to 20 ampere-hours, 1326 nlc nickel cadmium, 183 silver cadmium, and 125 silver zinc sealed cells. Variables examined include load, charge control, and temperature conditions.

38847 (SAND—78-1364) **Testing of a lithium battery for use in an earth penetrator.** Levy, S.C. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract AC04-76DP00789. 15p. Dep. NTIS, PC A02/MF A01.

A lithium—vanadium pentoxide battery, which was selected to maintain the memory content in a static CMOS RAM volatile semiconductor memory during flight tests of earth-penetrating devices, was tested over the operatingtemperature range -30° to +70°C and at shock levels of 10,000 g. The battery exceeded the life requirement of 45 days above 3 V at 1.5 mA under all conditions except continuous operation at 70°C, at which temperature a 29-day life was obtained. 6 figures, 6 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

38848 (AD-A—059300) **Observations of an operating zinc-pore electrode. Interim technical report.** Katan, T.; Savory, J.R.; Perkins, J. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 7 Sep 1978. Contract N00014-73-C-0397. 35p. NTIS PC A03/MF A01.

A single-pore cell with a 14-micrometer spacing is used as an analog of a porous zinc anode and cathode for examinations of surface morphology and reaction profile in 10 M KOH, saturated ZnO. At the anode the dissolution-precipitation mode of ZnO formation is corroborated and the effective depth of reaction penetration is initially 0.09 cm. Structure of the deposited ZnO film is determine by SEM to be porous with 80 percent porosity. At the cathode, H_2 bubbles are found to be related to the initiation and growth of zinc dendrites.

38849 (N—78-28624) **Solubility, stability, and electrochemical studies of sulfur—sulfide solutions in organic solvents.** Fielder, W.L.; Singer, J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1978. 43p. NTIS PC A03/MF A01.

A preliminary study of the sulfur electrode in organic solvents suggests that the system warrants further investigation for use in a low—temperature (100 to 120 deg C) Na—S secondary battery. A qualitative screening was undertaken at 120 C to determine the solubilities and stabilities of Na^2S and Na^2S^2 in representatives of many classes of organic solvents. From the screening and quantitative studies, two classes of solvents were selected for work: amides and cyclic polyalcohols. Voltammetric and Na-S cell charge discharge studies of sulfide solutions in organic solvents (e.g., N, N-dimethylformamide) at 120 C suggested that the reversibilities of the reactions on Pt or high density graphite were moderately poor. However, the sulfur electrode was indeed reducible (and oxidizable) through the range of elemental sulfur to Na^2S. Reactions and mechanisms are proposed for the oxidation reduction processes occurring at the sulfur electrode.

38850 **Sulfur cell construction and method.** King, R.N. (to Electric Power Research Inst., Inc.). US Patent 4,146,683. 27 Mar 1979. Filed date 4 Nov 1977. 6p.

An improved method and means for allowing a sodium sulfur cell to become more fully charged employs a wrapping of a plain-woven nautral fabric reduced in a vacuum furnace to carbon. The wrapping of woven carbon is interposed between a sulfurous electrolyte and the outside surface of a sodium electrolyte container.

38851 Electrochemical storage cell. Fischer, W.; Kleinschmager, H.; Haar, W.; Weddigen, G.; Rupp, W. US Patent 4,146,684. 27 Mar 1979. Priority date 24 Jul 1976, German, Federal Republic of (F.R. Germany), 6p.

An electrochemical storage cell or battery based on an alkali metal and sulfur has at least one anode chamber and at least one cathode chamber separated from each other by an ion-conducting solid electrolyte. Felt with coarse pores and/or low electric conductivity and felt with fine pores and/or higher electric conductivity are located in the cathode chamber, with the felt of coarse pores and/or low conductivity disposed near the solid electrolyte and the felt of fine pores and/or higher conductivity disposed further away from the solid electrolyte. This arrangement permits rapid and more complete recharging of the cell for covering peak loads in electrical networks. 5 figures.

38852 Phenolic resin composition and a battery separator impregnated therewith. Jones, R.T. (to Monsanto Co.). US Patent 4,146,686. 27 Mar 1979. Filed date 23 Jan 1978. 8p.

This invention relates to an improved resin composition comprising an admixture of a phenol-aldehyde resole resin and a particular surface active rewetting agent wherein the rewetting agent is a reaction product of a polypropylene glycol and maleic anhydride. 4 tables.

38853 Galvanic cell having rechargeable zinc electrode. von Benda, K. (to Firma Deutsche Automobilgesellschaft mbH). US Patent 4,145,482. 20 Mar 1979. Priority date 30 Jun 1972, German, Federal Republic of (F.R. Germany), 8p.

A galvanic cell comprises at least one rechargeable zinc electrode as anode, at least one other electrode as cathode, an electrolyte, and at least one foraminous, electrically conductive auxiliary structure interposed between every anode and cathode. The auxiliary structure is galvanically separated from the electrodes of the cell, and macroscopically visible electrolyte zinc deposition from the cell electrolyte thereon is only observed at potentials which are more negative than on a smooth nickel structure. 2 figures.

38854 Process for manufacture of positive electrode for lithium/metal sulfide secondary cell. Joo, L.A.; Miller, F.C. (to Great Lakes Carbon Corp.). US Patent 4,143,217. 6 Mar 1979. Filed date 3 Oct 1977. 4p.

A positive electrode for a rechargeable electrical energy storage device containing a lithium or lithium—aluminum negative electrode, an electrolyte with lithium ions, and a positive electrode formed by impregnating a molded iron sufide compact with a pitch or thermosetting resin and subsequently carbonizing the pitch or resin to form an in situ carbon structure, to serve as the foundation for the electrode.

38855 Lead crystal storage cells and storage devices made therefrom. Hradcovsky, R.R.; Kozak, O.R. (to Solargen Electronics, Ltd.). US Patent 4,143,216. 6 Mar 1979. Filed date 16 Mar 1978. 12p.

A unique storage cell is provided in which the active mass on the positive electrode is a mixture of crystalline and an effective amount of polycrystalline lead superoxide (PbO_2). These cells are characterized, inter alia, by their remarkably lower internal resistance, higher activity, better charging and discharging characteristics, lower sulfatization, higher storage capacity, and greater ability to draw larger amounts of electric current in a considerably shorter period of time as compared with conventional lead—acid storage cells. Storage devices (e.g., a battery) made from such cells also exhibit superior performance characteristics as compared with storage devices made from the conventional lead—acid cells. Batteries made from such cells are referred to as lead-crystal batteries. Also, several methods are described for making the polycrystalline and crystalline lead superoxide (active mass). 6 figures, 1 table.

38856 Cells having cathodes containing C/sub x/S cathode-active materials. Chang, C.H.; Longo, J.M. (to Exxon Research and Engineering Co.). US Patent 4,143,214. 6 Mar 1979. Filed date 26 Jun 1978. 10p.

The present invention is directed to an electric current-producing cell which contains an anode having as its anode-active material one or more alkali metals; a cathode having as its cathode-active material one or more carbon—sulfur compounds having the formula C/sub x/S, wherein x is a numerical value within the range of about 4 to about 50; and an electrolyte which is chemically inert with respect to the anode and cathode and which permits the migration of ions between the anode and cathode. 6 figures, 3 tables.

38857 Battery container having cast battery terminal formed therein. Mocas, V.A. (to The Richardson Co.). US Patent 4,143,215. 6 Mar 1979. Filed date 27 Nov 1974. 12p.

This invention relates to a method for forming metal battery terminals and to the terminals produced thereby for use with battery containers fabricated from thermally deformable materials such as polypropylene. The method involves casting the metal directly into place within and through the wall of such container. 7 figures.

38858 Electrochemical zinc—oxygen cell. Blanchart, A.P.O.; Spaepen, G.J.F.; De Brandt, C.W.M.V.A. (to Electrochemische Energieconversie N.V.). US Patent 4,137,371. 30 Jan 1979. Priority date 7 Jul 1976, Netherlands, 6p.

The invention relates to an electrochemical zinc—oxygen cell comprising an oxygen electrode containing a porous electrically conductive layer, a zinc electrode, a diffusion of zincate-restricting membrane, preferably an ion-exchanging membrane (which is joined directly to the oxygen electrode between the porous layer of this electrode and the zinc electrode), and an electrolyte space between the membrane and the zinc electrode containing a liquid basic electrolyte. By preference the membrane is only slightly permeable for the electrolyte. With this cell no poisoning of the electrochemically active material occurs. 3 figures.

ENERGY MANAGEMENT AND POLICY

38859 (UCRL—13970) **Study of set-theoretic information processing.** Childs, D.L. (STIS Corp., Ann Arbor, MI (USA)). 1 Mar 1978. Contract W-7405-ENG-48. 97p. Dep. NTIS, PC A05/MF A01.

This report by Set Theoretic Information Systems, Inc., was prepared in partial fulfillment of their contractural obligations to the Data Management Research Project of the Lawrence Livermore Laboratory, in behalf of LLL-Contract (RA) 76-12 for the Transportation Systems Center of the U.S. Department of Transportation. The main contract explored efficient means to identify and analyze the large collections of historic data which document the transport of goods and people by ships, planes, trains, and trucks. One approach under consideration was the use of extended set theory and software developed by Set Theoretic Information Systems. In this report the author addresses himself to seven tasks that range from a definition of the set-theoretic data manipulation concepts to the practical task of working with the CAB 586 Flight Service Segment Data Base.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 38870, 39028

38860 (BNL—25933) **Systems framework for energy analysis in developing countries.** Palmedo, P.F. (Brookhaven National Lab., Upton, NY (USA)). Oct 1978. Contract EY-76-C-02-0016. 18p. Dep. NTIS, PC A02/MF A01.

Economic development in the western industrialized mode has depended on an abundant supply of cheap energy. Just as the nations of the developing world are embarking on that same path of development, the world's supply of inexpensive fuel is rapidly being exhausted. These factors have led governments around the world to recognize the urgency of national energy planning. In this paper, criteria that successful energy planning must meet is outlined and some ways to go about such planning are suggested. Distinction is made between energy planning and energy policy analysis. The simplest distinction is that analysis supports planning. Planning involves the establishment of policies and plans to carry out these policies. Energy analysis or policy analysis evaluates the implications of alternative policies or decisions and thus provides a factual basis for making these decisions. Some concerns in national energy planning and policymaking considered are energy-investment decisions, pricing policy, energy-conservation policy, research and development policy, broad energy policies and strategies, and economic and social development planning. (MCW)

38861 (DOE/TIC—10108) **Historic and current energy analysis of Florida.** Sipe, N.G. (Florida Univ., Gainesville (USA)). 1978. Contract EY-76-S-05-4398. 105p. Dep. NTIS, PC A06/MF A01. Thesis.

Energy circuit models were utilized as tools to analyze and understand the energy basis of Florida's history. The state's past was divided into six periods based upon the type, amount, and availability of energy. Qualitative models showing the important flows and storages of energy were prepared for each of the first five periods. A quantitative evaluated model was developed for the most recent period (1947 to present) enumerating the internal energy flows and storages of the state as well as the external driving functions. Based on the analysis of Florida's past and current energy trends, three scenarios were developed for Florida's future: a continuation of a growth-oriented state; transformation to a steady state; and continued boom and then bust on present energy sources. Of these three,

the steady-state scenario was found to be the most desirable. To achieve a steady state, it was recommended that planners and decision-makers should: make people aware of limits of fossil-fuel reserves; develop adequate land-use controls to protect prime agricultural land from urban development; utilize the natural system to perform services now being done with fossil fuels; curtail the state's dependence on external driving functions; and develop only those energy sources that yield net energy.

38862 (PB—283949) **Energy analysis: a Tasmanian application.** Finney, A.J.T. (Tasmania Univ., Hobart (Australia). Environmental Studies). 1977. 52p. NTIS PC A04/MF A01.

This report gives a general account of the intimate relationship between energy use and economic activity and discusses the way this relationship is reflected in national statistics. It then describes the methodology of the technique of energy analysis and its application to the study of particular production systems, and outlines the approach and specific conventions adopted in the programme of investigation. Also, it surveys the broad features of energy supply and consumption in Tasmania.

38863 (PB—285642) **Large-scale energy planning models: a methodological analysis. Final report.** Brock, H.W.; Nesbitt, D.M. (Stanford Research Inst., Menlo Park, CA (USA)). May 1977. Contract NSF-C915. 350p. NTIS PC A15/MF A01.

The authors describe five well-known energy planning models with the aim of communicating a genuine understanding of exactly how the models work, what they achieve, and the general policy context in which they are relevant. The sectoral and geographic coverage and aggregation, input requirements, outputs and basic operation are discussed in separate chapters on (1) the Hudson-Jorgenson/Hnyilicza models, (2) the SRI National Energy Model, (3) the Brookhaven Energy System Optimization Model, (4) the Project Independence Evaluation System, and (5) the Dartmouth College Energy Model. An additional chapter systematically sets forth and interrelates the methodologies of these models.

38864 (TID—29389) **Descriptor variable representation of large-scale deterministic systems.** Cline, T.B.; Larson, R.E.; Luenberger, D.G.; Stengel, D.N.; Wall, K.D. (Systems Control, Inc., Palo Alto, CA (USA)). 1976. Contract EX-76-C-01-2090. 75p. Dep. NTIS, PC A04/MF A01.

This is the first interim report of research entitled, A Descriptor-Variable Approach to Large-Scale Systems, the objectives of which are to develop the theory of the descriptor-variable respresentation of large-scale systems and to develop algorithms that exploit the inherent structure of a system for the efficient solution of large-scale optimization problems. It is expected that better understanding of the nature of large-scale system behavior will be obtained through examination of the way in which such algorithms exploit structure; for example, the way in which interconnections between components are treated. The results obtained thus far in the pursuit of the first objective are detailed. The basic concepts and theory of the descriptor variable approach are described along with specific results for deterministic linear systems. An approach to the modeling of large-scale systems is outlined which uses the descriptor variable representation as the unifying concept. The descriptor variable approach is presented with detailed results for the deterministic linear system case, and the status of the theory developed thus far is discussed. Possible areas for fruitful further investigation are indicated. Some application areas in which examples of systems represented by descriptor variable models occur frequently are discussed.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 38342, 38366, 38367, 38861, 38863, 38874, 38894, 38905, 38912, 38916, 38925, 39031

38865 (PB—283809) **Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report.** Wieland, J.S.; Leistritz, F.L.; Murdock, S.H. (North Dakota State Univ., Fargo (USA). Dept. of Agricultural Economics). Oct 1977. 74p. NTIS PC A04/MF A01.

The prospect of extensive energy development in several western states has created considerable interest in potential employment opportunities, as well as possible social, economic, and environmental effects. In light of this interest, surveys were conducted during the period 1974 through 1976 to determine the socioeconomic characteristics of workers at seven coal mines and six electric generating plants in North Dakota, Montana, and Wyoming. Key factors influencing the number of workers that were hired locally were determined and a model to predict the local hire rate was developed. The key factors identified and used in the model were: population, distance from the community to the project, wage levels, number of employees at a project, number of employees at other projects in the area, and the total population of the area. Regression models were used to fit the data from the four local areas and the data were also combined for a regional model. Key factors influencing the residential choice of the nonlocal workers were also determined and a model to predict settlement patterns of the nonlocal workers was developed.

38866 (PB—285197) **Attracting OCS related onshore facilities and activities: an assessment of prospects for New York state and their economic benefits.** (New York State Dept. of Environmental Conservation, Albany (USA)). Oct 1977. 39p. NTIS PC A03/MF A01.

This report and two others, one dealing with the potential adverse economic implications for marine recreation and commercial fisheries, and the second, on the prospective contributions of OCS energy resources in meeting future energy needs of the state, together represent the economic studies completed under Item 8.7 of the first year OCS work program. Taken as a whole, these reports address the key economic implications, both beneficial and adverse, associated with the development of OCS energy resources.

38867 (PB—285198) **Marine related activities: an assessment of the economic impacts of OCS energy development.** (New York State Dept. of Environmental Conservation, Albany (USA)). Oct 1977. 78p. NTIS PC A05/MF A01.

The report focusses upon the potential implications of prospective Outer Continental Shelf (OCS) energy development activities to marine related recreational activity on the south shore of Long Island, and to New York State's Atlantic commercial fisheries. The characteristics and economic importance of these activities are briefly inventoried and assessment made concerning the potential adverse effects of OCS activities on recreational expenditures, commercial fisheries harvests, and related economic ramifications.

38868 (PB—285869) **Energy policies: Price impacts on the U.S. food system. Final agricultural economic report.** Van Arsdall, R.T.; Devlin, P.J. (Economics, Statistics, and Cooperatives Service, Washington, DC (USA)). Jul 1978. 48p. NTIS PC A03/MF A01.

Forthcoming energy policies should complement the goal of abundant food supplies at affordable prices, wherever possible. Energy costs represent 8 percent of farm production costs and 12 percent of the consumer food bill. It appears that energy price increases resulting from either the continuation of existing energy policies or the implementation of a moderate energy program could cause farm production costs to increase 2-3 percent from 1975 to 1985 in real terms, with the consumer food bill rising 4-5 percent in real terms.

38869 (PB—285870) **Action handbook for small communities facing rapid growth 'case study' Scobey, Montana. Final report.** Lamont, W. Jr; Murray, J.A. (Briscoe, Maphis, Murray and Lamont, Inc., Boulder, CO (USA)). Jun 1977. Contract EPA-68-01-3579. 132p. NTIS PC A07/MF A01.

This handbook was prepared for use by local communities that were anticipating growth impacts from energy development in the Rocky Mountain Region. Case studies were conducted in conjunction with preparation of the handbook. The report evaluates the current setting of the Scobey Community as to its capabilities and opportunities should growth occur. It suggests action programs which are based on the goals and policies suggested by the residents of the Scobey area. They have not necessarily been totally accepted by the community, but have been publicly reviewed and provide a sound basis from which to begin a program in Scobey.

38870 (TID—29393) **Descriptor analysis of economic systems.** Stengel, D.N. (Systems Control, Inc., Palo Alto, CA (USA)). Aug 1978. Contract EX-76-C-01-2090;ET-78-C-01-2858. 153p. Dep. NTIS, PC A08/MF A01.

Descriptor-variable theory is an emerging approach to the analysis of mathematical systems with chain structure. In a system possessing a chain structure, each system variable can be assigned to exactly one of a sequence of variable sets, such that each mathematical relationship involves variables in one set or two sequentially adjacent sets. This structure occurs naturally in expressing many economic systems, where the division into variable sets may correspond to time-increments, process locations, etc. The basic conepts used to study descriptor-variable systems are discussed. This new approach yields remarkable insights into four important topics in economic research beyond the understanding acquired using existing methodologies: the equilibrium of large economic systems, policy analysis using equilibrium models, the structural decomposition of dynamic economic models, and optimal control of dynamic economic systems.

38871 **Understanding of the importance of Arab/Islamic funds available for development projects and economic support.** Hashim, J. *OAPEC News Bull.;* **5**: No. 4, 29-35(Apr 1979).

Presented at the Financial Times Conference on Business in the Gulf, held in London on January 30, 1979.

The rapid growth of development funds from bilateral and multi-lateral institutions reflects the Arab and Islamic effort to aid economic development in developing countries, although the effort is small in comparison to global assistance. Started by the Kuwait government in 1961, the idea of regional assistance has grown into a number of overlapping funds. These funds provide long-term, guaranteed concessionary loans for specific projects, which are evaluated on the basis of their technical and economic feasibility. The funds exchange information and feasibility studies to compensate for a shortage of technical personnel. Financing procedures have evolved as an effort to support balance of payment imbalances.

38872 Science, technology, and development in a new social order. Rahman, A. (Council of Scientific and Industrial Research, New Delhi, India). *Sci. Public Policy;* **6**: No. 1, 12-24(Feb 1979).

International efforts by United Nations organizations to close the economic gap between advanced and developing countries will intensify during the remainder of this century. The UN Conference on Science and Technology for Development assumes that science and technology should be used to promote social and economic development in such a way as to enhance the natural and social environment and reduce inequalities between groups of people. Rapid technological change has developed a scientific elite which keeps and controls knowledge. Compartmentalization of this knowledge has led to technological problem solving, without regard to social and cultural costs.

38873 Mining in canada--a taxing experience. O'Brien, K. (Inco Ltd, Birmingham, Engl). *Can. Min. J.;* **99**: No. 10, 31, 33(Oct 1978).

Each province and each territory has enacted unique legislation applicable to mining profits calculated in its jurisdiction. Some provinces have altered their corporate income tax to have certain tax effects on mining profits. It is suggested that the federal and provincial governments agree to limit the top marginal rates consisting of the sum of the federal and provincial corporate income tax rates and the provincial mining tax rate to 50 per cent, and a degree of uniformity and simplicity be sought.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 38094, 38095, 38347, 38348, 38757, 38758, 39048, 39554, 39619

38874 Environmental pollution and energy: an economic evaluation. Lave, L.B. (Carnegie-Mellon Univ., Pittsburgh, PA); Silverman, L.P. *Mater. Soc.;* **3**: No. 2, 115-126(1979).

A summary of the economic theory of the environment and the principal tools used to evaluate economic actions concerning the environment reveals the complexity of the problems. Finding the effects of changes in ambient environmental quality on people, animals, plants, and the inanimate environment is difficult. For example, the effect of air pollution on health has been a subject of major controversy, even though it has been the subject of extensive research. Making intelligent public policy is even more difficult, since it involves estimating to what extent emissions can be lowered, and how the reduction in emissions will be translated into ambient environmental quality, at what costs are worth bearing and by whom. This should not be taken to imply that no progress is possible or that these problems are not scientific in nature. The social costs of poor environmental quality are immense; similarly, the costs of abating emissions are estimated to run to tens of billions of dollars per year. These problems are too large and too important to be relegated to decision-making by hunches. 63 references.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 38328, 38330, 38331, 38904, 38919, 38926, 38939, 39031, 39657

38875 (CONF-790331—1) **Brief review of the Resource Conservation and Recovery Act (RCRA) 1976.** Oakes, T.W.; Shank, K.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From Waste management seminar; Oak Ridge, TN, USA (6 Mar 1979).

RCRA was built on the foundation of the Solid Waste Disposal Act of 1965 and the Resource Recovery Act of 1970, and was developed to provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials, for the safe disposal of discarded materials, and to regulate the management of hazardous waste. EPA estimates that approximately 270,000 waste-generating facilities and 10,000 transporters will be regulated. Approximately 30,000 of that number will require treatment, storage, or disposal permits. Also under this Act, approximately 35 million metric tons/year of hazardous waste, mainly from industrial sources will be controlled. Another several hundred million tons/year of high-volume, relatively low risk waste, such as certain mining waste, will be brought under limited control pending further formulation of rules. (MCW)

38876 (PB—283827) **Final environmental impact report on the long range energy program for the California State Water Project. Final report.** (California Dept. of Water Resources, Sacramento (USA)). Apr 1977. 303p. NTIS PC A14/MF A01.

Operating the Department of Water Resources State Water Project requires large amounts of electrical energy. The Project also generates energy, some of which is used for pumping and some is sold to other utilities. The EIR explains how the need for energy and the estimated quantities of energy required for Project operation are determined by the amounts of water to be delivered. The environmental setting is discussed in general terms describing those features of the setting that could be affected by Program actions or alternative actions.

38877 (PB—283968) **Resources, residuals and irreversible land conversions: prototype management instruments.** Edens, T.C.; Mecuro, N. (Michigan State Univ., East Lansing (USA). Design and Management of Rural Ecosystems). Jul 1976. 45p. NTIS PC A03/MF A01.

Efforts to make production and consumption compatible with ecological and thermodynamic constraints will require changes in policy objectives concerning: (1) control of renewable residuals (water, forest products, solar energy, organic compounds); (2) control of irreversible land conversions; and (3) control of non-renewable resources (fossil fuels, uranium, steel). Alleviating these problems will require several policies affecting resource utilization and residual emissions. Efforts to make the present economic and social system compatible with future resource allocation and depletion will necessitate changing, altering, and redesigning the current structures.

38878 (PB—284014) **Energy R and D implications for Appalachia: An evaluation methodology. Volume I. Technical report. Final report.** (Mathtech, Inc., Princeton, NJ (USA)). Dec 1976. Contract ARC-75-185/CO-4428. 89p. NTIS PC A05/MF A01.

The Appalachian Regional Commission (ARC) in its role as coordinator for local and state authorities within the Region has sought to foster a balanced national energy R and D program that would also develop Appalachian resources and lead to the long-term economic health of Appalachia. The methodological framework developed, including program area ranking, the inventory of energy R and D projects assembled for 1973-75, the review of the existing energy R and D information sources, and the critique of historical energy R and D funding levels made as part of this project, provides an objective, structured, and systematic basis for making subjective evaluations of the relative priorities for energy R and D in the Appalachian Region.

38879 (PB—285713) **Water related constraints in energy production. Final report.** Hampton, N.F.; Ryan, B.Y. Jr. (Aerospace Corp., Germantown, MD (USA). Environment and Safety Directorate). Jun 1978. 271p. NTIS PC A12/MF A01.

This report seeks to elucidate the relationships between water resources and this Nation's efforts to achieve energy self-sufficiency. Water is demanded by the energy industries for mining, reclamation of mined lands, transportation, onsite processing and cooling, refining, and conversion of fuels to other forms of energy. In addition, water is demanded for municipal, industrial, agricultural, navigational, and recreational uses and to maintain ambient water quality and fish and wildlife habitats. Given these demands, conflicts in water resource allocation are likely to arise, particularly in areas of limited water supply. The information contained herein is intended to provide a first-order assessment preparatory to resource allocation decisionmaking.

38880 (PB—285746) **The nation's water resources, the Second National Water Assessment, summary report.** (Water Resources Council, Washington, DC (USA)). 13 Apr 1978. 58p. NTIS PC A04/MF A01.

This report is the Second National Assessment in brief. The results of the study are summarized in the report.

38881 (PB—285747) **The nation's water resources: the Second National Water Assessment. Part I. Introduction.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 44p. NTIS PC A03/MF A01.

This report states the purpose of the Assessment, which is to prepare recommendations to determine the adequacy of existing programs and policies.

38882 (PB—285748) **The nation's water resources: the Second National Water Assessment. Part II. Water management problem**

profiles. (Water Resources Council, Washington, DC (USA)). Apr 1978. 150p. NTIS PC A07/MF A01.

The chapters in this document pinpoint ten problems of national significance for analysis. The purpose is to increase awareness at all levels.

38883 (PB—285749) **The nation's water resources: the Second National Water Assessment. Part III. Functional water uses.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 386p. NTIS PC A07/MF A01.

The purpose of this report is to focus on the national perspectives regarding existing (1975) and future (1985 and 2000) requirements for water to meet offstream, instream, and flow management needs for eleven major functional categories.

38884 (PB—285750) **The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 246p. NTIS PC A07/MF A01.

This study presents an analysis of the water supplies of the 21 regions and 106 aggregated subregions of the U.S. This information was utilized to analyze water supply conditions. Water Quality is included, since quality may limit or restrict water availability.

38885 (PB—285751) **The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 206p. NTIS PC A10/MF A01.

This report is composed of summaries of the 21 Regional Assessment Reports. It presents estimates of physical and socio-economic data based on state-regional goals and objectives.

38886 (PB—285815) **The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data.** (Water Resources Council, Washington, DC (USA)). Apr 1978. 101p. NTIS PC A06/MF A01.

This document contains statements of methodologies and assumptions used in computing socio-economic characteristics and patterns of change and water-use data and water-supply data. It describe the methodologies and indicate where the data are located in the main report.

38887 (PB—286002) **The ground water and energy supply situation for Great Plains irrigation.** Sanghi, A.K.; Johnson, D. (Washington Univ., St. Louis, MO (USA). Center for the Biology of Natural Systems). Apr 1978. 43p. NTIS PC A03/MF A01.

This report assesses the energy supply and groundwater situations for irrigation in Texas, Oklahoma, Kansas, and Nebraska. The highly seasonal distribution of electricity demand for irrigation creates a peak load problem for electricity cooperatives in the region. This problem is most serious in Nebraska, where it has led to restrictions or delays in new irrigation hookups. A survey of available data on saturated thickness of the aquifer, depth to water table, and annual rate of decline (or rise) in the water table was conducted for counties in the four states overlying the Ogallala Formation. The most serious problems are in Texas, which has the greatest average depth to the water table, the greatest average yearly water table decline, and the lowest average saturated thickness.

38888 (PB—286038) **Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976—30 September 1977.** Davies, R.D.; Haines, B.A. (Washington State Water Research Center, Pullman (USA)). Jun 1978. Contract DI-14-31-0001-7101. 80p. NTIS PCA05/MF A01.

The legal doctrine that use of water must be reasonable has been interpreted recently by courts to prescribe some relatively common wasteful practices in the west. In this study relevant perceptions and attitudes of individuals interested and/or influential in Washington state water policy were surveyed by means of a mailed questionnaire. Most respondents agreed that water was becoming more scarce, and the principal causes of scarcity were felt to be insufficient precipitation, deficient storage, inadequate monitoring, lack of governmental planning and regulation, and wasteful practices by agricultural, municipal/domestic and industrial users. This suggests that efforts to promote conservation may be more effective if associations of water users are encouraged to participate more actively in them.

38889 **Kriging method versus classical statistics in estimating mineral reserves.** Sani, E. (Pennsylvania State Univ., University Park). *Mater. Soc.;* **3**: No. 2, 81-98(1979).

The purpose of this paper is to provide a decision maker with background information on what the Kriging technique is and how it can be used in reserve estimation. It does not attempt to offer a judgement as to whether or not the Kriging method is the best method for determining the amount of oil and gas in place, but concentrates on outlining the basic theoretical and practical principles of the Kriging method. Because the objective is to provide decision makers who are not well versed in advanced mathematics and statistics with a basic understanding of the Kriging method, the mathematical analysis is simplified as much as possible. Furthermore, the mathematical and statistical treatment of the theory is reduced to a necessary minimum and a detailed explanation of each step is provided. Following the introduction the six-part paper presents a discussion regarding the application of classical statistics to reserve estimation; outlines some important features of the theory of regionalized variables and also derives the semivariogram; discusses the Kriging and the Universal Kriging methods; and provides an example in which the classical statistical estimation method and the Kriging technique are applied to the estimation of the average grade of a silver block. 8 references.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 38872, 38929, 39527

38890 **Energy research and development programme: first status report (1975—1976).** The Hague, Netherlands; Martinus Nijhoff (1977). 375p. Kluwer Boston, Inc., 160 Old Derby St., Hingham, MA 02116.

This report presents the R and D work executed under contract in the framework of the Energy Research and Development Programme adopted by the Council of Ministers on 22 August 1975, a program dealing with the so-called new energies. After some general information on the program's objectives, its management and administration, a detailed description of each of the contracts concluded before 30 May 1977 is given. This description, which constitutes the main part of this report is subdivided into five chapters. Research in the particular area considered is described. This decision adopts an energy research and development program to be implemented under the responsibility of the Commission of the European Communities. It covers the following fields or sub-programs: energy conservation, production and utilization of hydrogen, solar energy, geothermal energy, and system analysis: development of models.

38891 (NP—23403) **Report of the Office of Science and Technology Policy Working Group on Basic Research in the Department of Energy .** (Department of Energy, Washington, DC (USA). Office of Science and Technology Policy). Jun 1978. 39p. TIC.

The OSTP Working Group was commissioned to advise on the scope and quality of basic research conducted by and on behalf of DOE. The Group formed Subgroups in these areas: large-scale solar, fossil, fusion, small technology, and geothermal, environment and life sciences, social sciences, transportation, and fission. Work of the Subgroups forms the basis of much of this report, which has five sections. Following the introduction, preface, and executive summary (Section II), there is discussion of broad problem areas as they pertain to research (Section III). Section IV consists of general recommendations regarding policies for, as well as management and scope of, research within the DOE: this section has four parts: Part A pertains to research in programmatic areas under the aegis of the Assistant Secretaries; Part B deals with the role and structure of the Office of Energy Research; Part C is concerned with broad research issues; and Part D addresses DOE Laboratories and Energy Research Centers. In Section V, research needs and opportunities for selected programs are discussed.

38892 (PB—284228) **Who's Who III in the Interagency Energy/Environment R and D Program.** Holte, H.O. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Jul 1977. Contract EPA-68-01-2934. 30p. NTIS PC A03/MF A01.

This directory provides a means of access to information on specific projects currently underway within the Interagency Program. The 14 major categories covered are: Characterization, measurement, and monitoring, Environmental transport processes, Health effects, Ecological effects, Integrated assessment, Energy resource extraction, Physical/chemical coal cleaning, Flue gas cleaning, Direct combustion, Synthetic fuels, Nuclear waste control, Thermal control, Improved efficiency, and Advanced energy systems.

38893 (PB—284375) **Who's Who IV in the Interagency Energy/Environment R and D Program.** Holte, H.O. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Jun 1978. Contract EPA-68-01-2934. 38p.

This publication documents major organizational aspects/functions of the Interagency Energy/Environment Program and associated points of contact.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 38221, 38223, 38246, 38509, 38688, 38757, 38758, 38759, 38810

38894 (INIS-mf—4521) **Social and economic impact of nuclear energy in Brazil. A structural analysis with a generalized input-output model.** Marques, E. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro; Paris-9 Univ., 75 (France)). 1976. 235p. (In French). Dep. NTIS (US Sales Only), PC A11/MF A01.

Tese (Ph.D.).

A model for structural analysis is introduced and discussed. An application is made to the 'Brazilian Nuclear System' defined by a structural matrix lying upon 42 factors (of which 11 are political, 7 economic, 9 technological, 6 sociological, 7 ecological and 2 psychological, whose interactions are evaluated. The hierarchical ordering of these 42 factors shows the preponderance of the political ones, the technological factors being the least important. The study is completed by calculating the impact of a PWR plant construction in Brazilian territory, using an enlarged input-output method the sectorial impacts are determined for industrial production, value added, indirect imports and capital goods industries.

38895 (PB—285131) **Report to the legislature on the constitutionality of California's nuclear laws.** (California Assembly Permanent Subcommittee on Energy, Sacramento (USA)). 1978. 131p. NTIS PC A07/MF A01.

This report sets forth in one volume all relevant documents relating to the constitutionality and enforceability of California's nuclear laws.

38896 (RAND-P—6115) **Comparative analysis of high technology programs: the development and diffusion of the nuclear power reactor in six nations.** deLeon, P. (RAND Corp., Santa Monica, CA (USA)). Aug 1978. 325p. Rand Corp., Santa Monica, CA.

A Policy Study is presented which represents an outgrowth of a Rand Corporation study sponsored by the National Science Foundation on the history of the light water reactor program. The comparative analysis of six national nuclear reactor programs should be of interest to a large community of scholors and practitioners, including those dealing with energy policy, technology assessment, government research and development of civilian technologies, comparative policy analysis, and the interaction between organizations and emerging technologies. Although the evidence is not sufficient to support or validate a full-blown theory of technology development, some attempt is made to suggest possible avenues for future theoretical exploration in that vein.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 38110, 38128, 38830

38897 (CONF-781213—6) **Cost-allocation model for assessing the impact of energy-storage technologies upon electric utilities.** Giese, R.; Holt, L.; Scheithauer, R. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 13p. Dep. NTIS, MF A01.

From Winter simulation conference; Miami Beach, FL, USA (4 Dec 1978).

Portions of document are illegible.

In order to assist DOE in prioritizing, developing, and commercializing storage technologies, a computer simulation code was developed to assess the impact of alternative residential heating and cooling technologies upon electric utility generation, transmission, and distribution systems. Given input information such as plant capacity, forced-outage rates, scheduled maintenance requirements, and economic data for individual generating units, the program uses hourly utility load data together with synoptic weather data to simulate system loads and costs for specified levels of heating/cooling technology penetration. The program performs five categories of calculations: simulation of residential load, aggregation and propagation of loads through the distribution and transmission subsystems, economic dispatch of generating plant, scheduling of plant maintenance, and calculation of optimal generating plant mix. Originally designed to study the impact of shifting on-peak demand to off-peak periods through the use of customer-owned thermal storage, the code has been extended to handle a variety of electric heating and cooling technologies. Results are presented for residential space-conditioning systems for two representative utility-service areas. In the service area supplied by a winter-peaking utility, the lowest-cost space-heating technologies were found to be storage-augmented either by storage or by an oil furnace.Heat pumps were the most economical heating systems in the service area supplied by the summer-peaking utility while storage air conditioning was cost-effective for cooling in the summer-peaking service area.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 38485, 38566

CONSERVATION

REFER ALSO TO CITATION(S) 38993, 39004, 39007, 39008, 39009, 39012, 39013, 39014, 39029, 39030, 39038

38898 **Possibilities and limits of energy conservation in the Federal Republic.** Pfaffenberger, W.; Meyer-Renschhausen, M. *Bl. Dtsch. Int. Polit.;* 23: No. 7, 821-841(1978). (In German).

After many conflicts between coalitions and opposition which lasted over months, the Federal Government passed on 22 June, 1978 an energy program, which will be carried out jointly by the Federal Government and by the States. It provides for grants and tax concessions for measures to save heating energy and, in general, is confined to various segments of energy conservation..

38899 (DOE/TIC—10062) **Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Sep 1978. Contract EM-77-C-01-8962. 18p. Dep. NTIS, PC A02/MF A01.

In announcing that conservation of energy is the cornerstone of the National Energy Plan, the President issued Executive Order 12003 on July 20, 1977, directing that all Federal agencies set the example in conservation by upgrading the efficiency of all Government buildings and operations so as to achieve sizable energy savings. A Managerial Plan was developed as a basic document to serve the needs of various levels of management. This synopsis of the plan is intended for use by participating agencies concerned with meeting the program requirements of the Executive Order and for use by DOE during interagency seminars and workshops.

38900 (DOE/TIC—10065) **Briefings related to Executive Order 12003 and the National Energy Act.** (Department of Energy, Washington, DC (USA)). Nov 1978. Contract EM-77-C-01-8962. 63p. Dep. NTIS, PC A04/MF A01.

This report consists of a packet of four briefings, namely: (1) Managerial Plan Executive Order 12003 and The National Energy Act--outlines the Plan and covers some of the historical background that preceded the presidential issuance of EO 12003 program; (2) Roles and Responsibilities: EO 12003, NEA, and other authorities discusses all the program elements in terms of EO 12003, NEA, and other authorities; points out areas of contradiction, overlapping authorities, and the potential for confrontations that could have an impact on achieving the Presidential goals and meeting the legislative requirements; identifies the problem, analyzes the situation in terms of DOE, agencies, OMB, GAO, Executive and Congressional positions and weighs the advantages and disadvantages of the various options available; (3) Impact of the National Energy Act (NEA) on the Federal Energy Management Program (FEMP)--covers the history of FEMP and the Federal Program Office, its prior relationship to the agencies, the authorities that developed to date, the problems, and the potential for disagreements deleterious to the program's goals; and (4) Proposed Interagency Task Group--designated as the Federal Energy Management and Policy Group (FEMG) and described by eight charts and accompanying textual material. The supporting graphics for the briefings are included. (MCW)

38901 (DOE/TIC—10066) **Recommended changes to Executive Order 12003 and related authorities.** (Unified Industries, Inc., Alexandria, VA (USA)). 27 Oct 1978. Contract EM-77-C-01-8962. 9p. Dep. NTIS, PC A02/MF A01.

President Carter issued Executive Order 12003 on July 20, 1977, directing that all Federal agencies set the example in conservation by upgrading the efficiency of all Government buildings and operations so as to achieve sizable energy savings; this was to further implement the Energy Policy and Conservation Act of 1975 (EPCA 381) and its Federal 10-year building plan and modify Executive Order 11912(1976). However, adjustments to EO 12003 and the National Energy Act (NEA) of 1978 definition of a building will be required to eliminate the need to include leased (new) buildings in the 45 percent energy-reduction requirement. Again, flexibility is provided to DOE and the agencies in meeting the spirit of the directive "to the maximum extent practicable." Additionally, with the NEA only recently passed, it would be far more prudent and effective to adjust the Executive Order to existing legislation. Ten changes that are required at this time are, therefore, directed at EO 12003 and are reflected in a table. It is noted that the changes, if approved, would be even more prescriptive and detailed than the original directives.

38902 (HCP/M—2165) **Energy conservation technology education program. Final report.** (League of Women Voters Education Fund, Washington, DC (USA)). Jan 1979. Contract EC-77-C-01-2165. 106p. Dep. NTIS, PC A06/MF A01.

In May 1977, the League of Women Voters Education Fund (LWVEF) contracted with the Division of Buildings and Community Systems of DOE to conduct pilot projects in four communities to demonstrate how to use energy more efficiently in the home. The project covered a one-year period. The areas chosen for the projects were Tucson, AZ; West Hartford, CT; Northfield, MN; and Wake County, NC. Through public meetings, how-to clinics, and clearinghouse services, 18,051 people were reached directly through project activities. It was determined that most people feel that an energy shortage exists and that there is a need for conservation of energy. People feel that they can make an impact on reducing energy consumption, but only seem willing to undertake easy-to-do conservation methods. Skepticism continues to pervade citizen reaction to government; there is a continuing and increased distrust of politicians and government, utilities, and energy companies. Coupled with public skepticism and cynicism toward government and business is the rip-off syndrome. Many people felt victimized by high utility bills, insulation companies, etc. Part One of the report consists of summaries of the activities and findings of the pilot projects and Part Two consists of an assessment of LWVEF program management. (MCW)

38903 (PB—285508) **Vermont energy conservation plan.** (Vermont State Energy Office, Montpelier (USA)). 15 Jun 1977. 274p. NTIS PC A12/MF A01.

The Energy Conservation Plan reflects Vermont's participation in the programs of the National Energy Policy and Conservation Act (EPCA) of 1975. (Portions of this document are not fully legible)

38904 (PB—285510) **University of Wyoming Energy Symposium.** (Wyoming Univ., Laramie (USA)). 28 Mar 1977. 42p. NTIS PC A03/MF A01.

The following topics were discussed: the energy view from the capitol; Wyoming energy conservation; alternate energy sources; and state energy conservation planning.

38905 **Energy saved is cheaper than energy generated.** van Dam, A. *Sci. Public Policy;* **6**: No. 1, 2-5(Feb 1979).

The reduction of energy waste may be the major challenge of the 1980s because it can buy the time needed to explore and develop other energy sources without the high cost of fueling non-productive energy consumption with petroleum. Energy conservation in transportation will have the greatest impact, but this will require radical changes in vehicle design and human behavior. New lifestyles in both housing and transportation may evolve into a compromise on comfort and a shortening of the food chain. If the cost of goods is measured in energetic content rather than material affluence, the quality of life can be improved and economic growth occur in spite of energy conservation. 7 references.

38906 **Energy managers focus on 1979 conservation plans.** *Energy User News;* **4**: No. 1, 1, 4-6(1 Jan 1979).

Many energy managers view 1979 as a period of maturation for programs begun during the 1973 oil embargo. A survey of Midwest managers indicates they will focus on capital projects aimed at reducing energy consumption, although they agree that the 10 percent investment tax credit was not the motivating factor. Among those surveyed, rising energy costs justify investments in heat recovery equipment, energy management systems, coal conversion, and general housekeeping measures. They note that utility rate structures will determine which areas will invest most heavily in control systems. Some capital investments will suffer from a lack of available capital and Federal regulations governing fuel use. Manufacturers of energy-related equipment and insulation see the market expanding because of tax credits, state building guidelines, and the interest in upgrading existing facilities. Fuel options are reviewed in terms of supply, costs, and implementation of new government regulations.

38907 **Office of Conservation third quarterly report, July—September 1978.** Seattle, WA; Seattle City Light (1978). 127p. (NP—23636).

During the third quarter of 1978 (July through September), Seattle City Light's Conservation Program realized significant achievements toward the program goal of a 230 MW reduction in load by the year 1990. This overview summarizes these activities. Descriptions are detailed for the project goal, objectives, activity highlights, authority, evaluation, and costs to date. The categories and projects are: commercial/industrial (energy management seminar, utility training seminar, workshops); residential (workshop/audits, energy management information system, insulation demonstration program, utility/bank/contractor insulation program); outreach (community outreach, energy information center, education outreach); in-house conservation (energy management of physical systems); research, development, and demonstration in the commercial/industrial sector (waste heat utilization); residential (neighborhood conservation demonstration program, water heater conservation study); and support activities (legislative and barrier analysis, evaluation. The attachments portion of the report contains up-dated interdivisional management plan for each project and other related project information. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 38127, 38175, 38906, 38924, 38935

38908 (AD-A—057953) **Fair allocations of a renewable resource. Research report.** Sobel, J. (California Univ., Berkeley (USA). Operations Research Center). Nov 1977. Contract N00014-76-C-0134. 28p. NTIS PC A03/MF A01.

In an economy with finitely many agents, one renewable resource and an infinite horizon, it is shown that there is exactly one maximal allocation corresponding to given limiting shares of consumption and this allocation converges monotonically. Therefore, if there is no discounting, at most one fair maximal program exists - that which gives an equal amount to each individual in the limit. In this allocation, envy is always finite. However, only in special cases is it envy-free. This is in contrast to the case of finite economies where envy-free and Pareto efficient allocations may not exist, or if they exist may not be unique.

38909 (ANL/EES-TM—40) **Midwestern energy supply issues: a survey of state views.** Hilton, M.L.; Ballou, S.W. (Argonne National Lab., IL (USA)). Sep 1978. Contract W-31-109-ENG-38. 53p. Dep. NTIS, PC A04/MF A01.

This survey was designed to identify Midwestern energy problems and possible solutions to those problems. Among the problems identified through the survey were temporary fuel shortages and fuel distribution problems such as those caused by two unusually severe winters and the prolonged coal strike of 1977—78. An additional concern was the availability of fuels and electric-generating capacity over the next 10 to 15 years. Survey respondents cited several factors as having contributed to these temporary and long-term energy supply problems. The current economic situation was linked to the lack of investment in new energy technologies, while environmental factors such as the air pollution associated with coal combustion could prevent energy demands from being met. Planners in Midwestern energy organizations are considering several possible solutions to short and long-term energy shortages, namely: (1) development of innovative energy-supply systems to help meet future demands within existing environmental, legal, and economic constraints; (2) reduction of demand and more-efficient use of existing supplies; and (3) development of laws and regulations. Laws may be used to implement other solution strategies, including conservation and research, or to mitigate adverse environmental impacts that would otherwise constrain the use of some fuels. Severl survey questions focused on stateenergy and environmental policies.

38910 (DOE/EIA—0135) **Energy Emergency Management Information System (EEMIS): program plan.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1979. 123p. Dep. NTIS, PC A06/MF A01.

Fuel shortages in recent winters have reinforced the need for better information and communications in an energy emergency. Information is needed by policymakers in order to understand and make rational decisions regarding the current status of emergency program operations at Federal and state levels. EIA established the EEMIS Project Office in June 1978 to develop the system. This program plan, that has been refined as a result of a public review process, lays out the general development plan. Potential causes of fuel shortages are: sudden decreases in petroleum imports, gaseous fuel supplies, and petroleum production in the US; regional transportation outages; sudden decrease in coal production in the US; unanticipated heavy regional demand; and disruption of power plant operations. EEMIS will be called upon to provide information to users in responding to these situations as soon as fuel supply/demand imbalances are anticipated. (MCW)

38911 (NP—23704) **Activity report for the period between July 1 and September 31, 1977.** (Koeln Univ. (Germany, F.R.). Energiewirtschaftliches Inst.). 1977. 19p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The activities of the Energiewirtschaftl. Institute in the 2nd half of 1977 are reviewed. This includes teaching activities, publications, journals, lectures, experts' opinions, international contacts, technical advice, theses, and dissertations.

38912 (PNL—2410-1(Rev.)) **Analysis of Federal incentives used to stimulate energy production.** Cone, B.W.; Brenchley, D.L.; Brix,

V.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1978. Contract EY-76-C-06-1830. 400p. Dep. NTIS, PC A17/MF A01.

In March 1978, Battelle published An Analysis of Federal Incentives Used to Stimulate Energy Production, concentrating primarily on solar energy incentives. Since that time, considerable discussion has centered around the analysis contained there. This revision identifies those areas that have been revised so that individuals who reviewed the March edition may note the changes without re-reading the entire document. Changes which affect the study overall include the addition of 1977 data to the tables and the revision of dollar values previously in terms of constant 1976 dollars to constant 1977 dollars. A chapter which analyzes Federal incentives to encourage public utility generation and transmission of electricity has been added. Other changes are contained in the nuclear chapter which now includes estimates of the incentives provided to the nuclear industry from government sponsored educational programs and the Naval Reactors Program. Conclusions with respect to solar energy policy are presented in a final chapter. There are 5 appendices, 234 references, and an extensive bibliography.

38913 **Energy scenarios: details of supplementary studies.** Harris, G.S.; Ellis, M.J.; Scott, G.C.; Wood, J.R.; Phillips, P.H.; Isaacs, N.P. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1978). 119p. (NZERDC—34).

Three different paths for New Zealand's energy future were discussed in the Energy Research Group's first report, Energy Scenarios for New Zealand (See NP—22250; EAPA 4:4113). The three secnarios - continuation, low New Zealand pollution, and limited growth - demonstrated the energy implications of differnt social attitudes to material wealth, environment, and resources. Additional work has been undertaken on four of the most important problems on which it was felt the Scenarios provided insufficient information: efficiency measures, liquid fuels, renewable sources,and nuclear power. These studies attempt to answer questions about the impact of particular policy options on energy supplies. They all use the economic structure of the continuation scenario for determining energy demands, thereby providing a basis for direct comparison. These supplementary studies are not new scenarios; changing the supply strategy without making corresponding shifts in the economy creates many inconsistencies between the pattern of energy supply and demand. Themes of the three new studies used in modifying the energy supplies and demands of continuation are: energy demands of the continuation scenario are reduced by greater efficiency in the production and use of energy, and some recycling of materials; imports of fossil energy are reduced as much as possible while using nuclear power to aid the solution of the liquid fuels problems; and energy demands of continuation are supplied from indigenous renewable sources of energy. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 38128, 38339, 38688, 38860, 38874, 38875, 38895, 38898, 38899, 38900, 38901, 38906, 38910, 38934, 39008

38914 (AD-A—058054) **U.S. Navy energy plan and program, 1978. Technical report.** (Tetra Tech, Inc., Arlington, VA (USA)). Jun 1978. Contract N00014-78-C-0097. 212p. NTIS PC A10/MF A01.

The 1978 U.S. Navy Energy Plan and Program is intended to keep the CNO appraised of the Navy energy situation and to update Navy energy program goals in light of presidential executive orders and DOD directives. The plan and program includes a brief overview of the world, national and Navy energy situations; Navy energy objectives and goals; a summary of program accomplishments; a description of the approved FYDP (POM-79) Navy energy program; and a description of an expanded energy program required to meet federally mandated goals. (Author)

38915 (AD-A—058200) **The Department of Defense's alternate energy policy. Final report.** Lucas, W.J. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA)). 9 Jun 1978. 81p.

The thesis examines the question of the scarcity of petroleum-based fuels early in the Twenty-First Century and the DOD policy and programs to meet this shortage. Based on the fact that petroleum fuels as we know them will not be available early in the Twenty-First Century, this study examines the uniqueness of the DOD's world-wide mission and its dependence on petroleum fuels for its main weapon systems. Because of this uniqueness, it was concluded that the DOD needs an alternative fuels policy independent of other governmental agencies to meet the national security requirements. The current DOD policy on alternative fuels for the future is examined. This investigation revealed that, as of January 1978, the DOD did not have a comprehensive policy for alternative fuels. Further, the direction of Research and Development efforts has suffered as a result of this lack of policy. Lastly, the study offers a proposed policy for consideration. Recommendations for both short- and long-range goals are proposed. Conclusions were that an alternative fuels policy is absolutely necessary and that a policy needs to be established as soon as possible.

38916 (DOE/EIA—0102/39) **Motor gasoline prices through 1980 under continued DOE price controls.** Farmer, R. (Department of Energy, Washington, DC (USA)). 10 Jan 1979. 38p. Dep. NTIS, PC A03/MF A01.

This memorandum presents a range of motor gasoline price increases allowable both under current DOE pricing rules and with the proposed "gasoline tilt" ruling, and evaluates the flexibility refiners have in setting prices under controls. The analysis uses EIA's Short-Term Petroleum Cost Distribution Model (STPCDM) to project price increases and refiner's banks of unrecouped costs. The analysis indicates that: (1) 1979 OPEC crude oil price hikes will increase refiner costs and, subsequently, gasoline prices by less than three cents per gallon; (2) continuation of current DOE rules allowing prorata volumetric passthrough of costs could constrain prices to levels lower than would be expected if prices increased with inflation; (3) a proposal to allow greater than volumetric passthrough (gasoline tilt) would permit retail prices to be increased at a higher rate than general inflation; (4) the 1979 OPEC price increase, if not followed by a 1980 increase, will not result in 1980 gasoline prices significantly different from the case where imported prices continue to increase with U.S. domestic inflation over that period; and (5) under current DOE pricing rules, attempts by refiners to increase retail prices at the same rate as general inflation by drawing down bank of past unrecouped costs would result in unprecedented low bank levels by the end of 1979.

38917 (ORAU/IEA—79-5(0)) **Energy policy and mathematics.** Weinberg, A.M. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Mar 1979. Contract EY-76-C-05-0033. 22p. Dep. NTIS, PC A02/MF A01.

Energy policy analysis generally requires estimates of the future. Such estimates are uncertain, not only because the mathematical models on which estimates are based are uncertain, but also because the nonlinear equations that describe the phenomena may have chaotic solutions and therefore may be inherently undecidable. It is suggested that inherent undecidability may to some degree be finessed by development of technological options whose feasibility can be established with the help of deterministic mathematics.

38918 (PB—283971) **The Presidential energy initiatives: Some relevant policy considerations.** Kalter, R.J. (Cornell Univ., Ithaca, NY (USA). Dept. of Agricultural Economics). Jun 1977. 37p. NTIS PC A03/MF A01.

This research addresses some relevant policy considerations for Presidential energy initiatives. Three diverse areas of concern include: (1) estimates of the price elasticity of supply (supply response to price changes) for petroleum and natural gas from future discoveries in the Outer Continental Shelf (OCS) and Alaska; (2) estimates of the impact of deregulated domestic petroleum prices on energy industry profits and capital financing requirements; and (3) estimates of the number and location of future coal mine developments necessary to meet stipulated consumption levels and sulfur constraints.

38919 (PB—284103) **Codified and uncodified state laws and agency rules and regulations bearing on water and related land resources in Minnesota. Volume 1.** LaChapelle, A.W. (Minnesota Univ., Minneapolis (USA). Water Resources Research Center). Jun 1978. Contract DI-14-34-0001-8025. 703p. NTIS PC A99/MF A01.

This publication is a source reference for law-makers, administrators, planners, lawyers, engineers, and others interested in water resource use, development, and management. It contains a compilation of all pertinent (1) codified Minnesota state laws as of fiscal year 1977. The codified laws are contained entirely in Volume 1 along with an Analytical Table of Chapters of included statutory material.

38920 (PB—284145) **Aspects of public utility regulation. Staff research report.** (Ohio Legislative Service Commission, Columbus (USA)). Jun 1977. 278p. NTIS PC A13/MF A01.

The report examines the structuring of public utility rates; provides comparative information about certain aspects of the operations of public utilities commissions in the United States; examines the organization and management of the Public Utilities Commission of Ohio.

38921 (PB—285062) **State energy management: The California Energy Resources Conservation and Development Commission. (innovations transfer: new approaches by the states).** Jarrett, J.; Howard, D. (Council of State Governments, Lexington, KY (USA)). May 1976. 67p. NTIS PC A04/MF A01.

The program of the California Energy Resources Conservation and Development Commission is described and evaluated as it may relate to the needs of other states to develop long-term energy decision-making procedures. Functional areas assigned to the commission such as siting of electrical energy facilities, conservation programs and standards, energy demand and supply forecasting, research and development on alternative energy supplies, and emergency allocation are discussed. This report is one of a series of similar reports documenting case examples of innovations in the policy process, administrative management, and program operations of state governments.

38922 Concluding statement of the First Arab Energy Conference, Abu Dhabi, United Arab Emirates. March 4—8, 1979. *OAPEC News Bull.;* 5: No. 4, 6-11(Apr 1979).

The First Arab Energy Conference was held in 1979 for the purpose of discussing the international and Arab implications of energy and to form a policy that will enable the Organization of Arab Petroleum Exporting Countries (OPEC) members to define and meet their energy requirements. Representatives agreed to establish a program of data compilation, storage, and analysis; to emphasize joint Arab projects; and to set up recommendations for energy committee in each Arab country as well as a pan-Arab committee. A joint Arab Energy Committee was approved and a date set for a second conference in 1982.

38923 Energy situation in the Arab world. *OAPEC News Bull.;* 5: No. 4, 12-17(Apr 1979).

Reports given by Libyan Arab Jamahiriya and Saudi Arabia at the First Arab Energy Conference are summarized. The Libyan report covers energy consumption, electricity generation, crude oil production, and describes an energy policy aimed at diversified energy sources and subsidized local energy prices. Saudi Arabia reported on energy consumption by sector, plans to expand the refining industry in several locations, and pricing policies aimed at providing low-priced energy to both individuals and institutions.

38924 Energy policy prospects as viewed by the Federal Government. Rohwedder, D. Z. *Energiewirtsch.;* No. 1, 31-37(1977). (In German).

The supply and demand situation on the world energy markets is investigated to outline the framework of the national energy policy. The possibilities and targets of a national energy policy are then discussed. The energy programme of the Federal Government and its continuation give guidelines particularly on energy saving and diversification of the energy supply, coal and nuclear energy, being of particular importance. The safety of energy supply of the future greatly depends on to what extent today's energy policy can form the future lines in time through programmes and control measures (financial incentives, payments).

38925 Horizontal divestiture of energy companies. Ruefli, T.; Askari, H.; Kennedy, M. Austin, TX; Univ. of Texas (1977). 22p. (NP—23735).

Discussions in the past have centered around both vertical (company ownership of production, refining, transportation, marketing) and horizontal (company ownership of oil, coal, uranium, shale, and other energy sources) integration. Many think that integration of either type is undesirable and propose instead, divestiture - breaking up the energy companies in component parts. Vertical divestiture would break up an oil company into producing, refining, and marketing components. Horizontal divestiture would break up an oil company into producing, refining, and marketing components. Horizontal divestiture would require oil companies to divest themselves of business operations in non-petroleum energy energies. Measures of competition, impacts of divestiture, an alternative to divestiture, energy company growth, and macroconcentration are discussed. It is concluded that no evidence exists to support charges of substantial uncompetitive behavior (beyond that introduced by the Federal government) in the energy industry. Further, it is possible, through a rational leasing policy and a coordinated merger policy, for the Federal government to insure a continued competitive energy industry without impairing the supplying of energy to the nation. The authors propose that if the Congress is determined to take some policy action, then a well-planned leasing policy coupled with a merger policy within an overall U.S. energy plan or framework - a critical item that the nation imperatively needs but is still lacking - is superior to that of legislated divestiture. (MCW)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 38925

COAL

REFER ALSO TO CITATION(S) 38047, 38094, 38095, 38110, 38127, 38128

38926 (ORNL/OEPA—12) **Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States.** Calzonetti, F.J. (Oak Ridge National Lab., TN (USA)). Feb 1979. Contract W-7405-ENG-26. 42p. Dep. NTIS, PC A03@MF A01.

It is likely that the cost of waste storage will be more expensive at sandy sites than at sites over clay soils. Facilities holding wastes that are sited at sandy locations are likely to have serious leachate contamination problems forcing the developer to take special precautions or use expensive pond liners, such as membranes. The Resource Conservation and Recovery Act (RCRA) may add to the attractiveness of using low-ash coals because the amount of wastes generated depends critically on the amount of noncombustible material in the coal. Because the largest deposits of low-ash coal occur in the West, it is possible that RCRA may increase the attractiveness of western sites over eastern ones. RCRA will probably decrease the attractiveness of urban locations for new energy facilities. Hazardous waste regulations explicitly preclude facilities from being sited in congested areas. Utilization of the recovered material produced in the largest volumes (ash and sulfur) will require imagination and new applications). Most facilities producing the largest volumes of heavy, inexpensive substances are to be located far from the traditional markets and off barge-scale, navigable rivers. Long-distance overland hauls of ash and sulfur are infeasible. Ways must be developed to use such materials near where they are being produced. Markets for fly and bottom ash can be widespread if thesubstance is publicly accepted. Ash has been demonstrated to be a quality road-building aggregate. Markets for sulfur are more regionally concentrated than those for ash. Sulfuric acid production facilities are the largest consumers of sulfur in the nation. Most of these facilities are located on the Gulf Coast, in California and Illinois. 53 references.

PETROLEUM

REFER ALSO TO CITATION(S) 38866, 38867, 38916, 38922, 38923

38927 Activities of the Iraqi State Establishment for oil projects. *OAPEC News Bull.;* 5: No. 4, 18-20(Apr 1979).

Thirty-two major energy-related projects were pursued in Iraq during 1978 at a cost of 1,051 million Iraqi dollars. This represented a one-year increase from six percent to 26 percent of the planned projects. Completed projects included oil fields, a lube-oil and a liquid-petroleum-gas plant, a refinery, and two pipelines. Construction on the remaining projects was begun in 1978 or planned for the near future.

38928 Crude oil and products markets in industrial countries. VII. Japan. *OAPEC News Bull.;* 5: No. 4, 21-24(Apr 1979).

Japan's crude oil and products markets during the 1973-77 period are reported. Consumption patterns show a decline and a slower rate of growth after 1973, with the greatest decline in fuel oil and an increase in the consumption of kerosene and diesel fuel. There was an excess of product consumption over product disposal in the 1973-75 market, making Japan a net importer of petroleum products. Japan has increased imports from the Organization of Petroleum Exporting Countries (OPEC) while dropping those from non-OPEC countries to one tenth of a percent. Prices and taxes on petroleum products are high in Japan, where there is a statistical trend toward reducing dependence on oil.

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 38047, 38591, 38890

ELECTRIC POWER

REFER ALSO TO CITATION(S) 38325, 38326, 38328, 38339, 38341, 38343, 38346, 38347, 38348, 38876, 38897, 38912, 38920, 39003

38929 (EPRI-PS—952-SR) **1979 Research Program.** (Electric Power Research Inst., Palo Alto, CA (USA)). 2 Nov 1978. 310p. Dep. NTIS, PC A14/MF A01.

This working draft describes in detail the proposed research program of EPRI for 1979. It includes a description of the planned research and development projects for each of the Institute's 34 technical programs in 4 technical divisions: Fossil Fuel and Advanced Systems, Nuclear Power, Electrical Systems, and Energy

Analysis and Environment. Responsibility for management of the technical programs is assigned to these divisions. This document provides: an overview of the divisions programs, including funding levels for 1978 and 1979 and a list of the major projectives to be accomplished in the planning period and an overview of each program, including funding levels for 1978 and 1979; program summary; key event review (1978—1979); list of existing projects by subprograms that will continue in 1979; list of new work planned for 1979; and list of future projects under consideration. A summary of the 1979 Research Program Budget is included. (MCW)

38930 (HCP/B8072—01) **Demand management demonstration project. Stage 1: development of residential load characteristics and Stage 4: demonstration of residential incremental cost pricing implemented by time-of-day metering. Final report, January 1979.** (Ohio Public Utilities Commission, Columbus (USA)). Apr 1979. 144p. Dep. NTIS, PC A07/MF A01.

In March of 1975 The Ohio Public Utilities Commission entered into a cooperative agreement with the Federal Energy Administration to conduct a Demand Management Demonstration Project involving a Residential Load Survey, Time-of-Day Pricing, Radio-Controlled Interruption of Space Conditioning, Industrial Load Shaping, Electrical Thermal Storage, and associated software development. The Dayton Power and Light Company, Toledo Edison Company, Buckeye Power Company, and Motorola Corporation agreed to participate as partners in the various stages of the project. The objectives of the project were to gain experience with several load-management technologies, gather data necessary for further implementation, gain insight into customer reactions to the various techniques studied, and develop the computer codes necessary to process such data. The results are consistent with economic theory and will contribute to the further development of effective pricing structures for electricity. The customers on the time-of-day rate responded by reducing their peak-period consumption significantly below that of comparable control-group customers. Total energy use by customers in the pricing group declined about 3.5%. Customers in the time-of-use and radio-controlled groups reacted favorably to the techniques.

38931 (PB—285260) **An annotated compilation of the sources of information related to the usage of electricity in non-industrial applications. Final report.** Reznek, B. (Reznek (Ben), Silver Spring, MD (USA)). Jul 1978. 690p. NTIS PC A99/MF A01.

The report is a thorough compilation of the sources of information related to the usage of electricity in non-industrial applications, as available in the open literature and from the U.S. electrical power industry. The report's scope encompasses all aspects of: electric load management; end-use; and the various methods of acquisition, analysis, and implementation of electricity usage data. There are over 400 abstracts; 156 from LRC/AEIC reports, and 264 from the open literature. The abstracts cover references containing over 12,000 pages plus about 2,500 references and 6,200 graphs and tables pertinent to electricity usage in non-industrial applications. In addition to the LRC/AEIC abstracts, this document identifies over 100 sources of directly relevant information (in contrast to general interest sources and material of secondary relevance).

38932 (RAND/R—2278-DWP/NSF) **Los Angeles senior citizen lifeline electricity rates.** Sullivan, T.J. (RAND Corp., Santa Monica, CA (USA)). Jan 1979. Contract EM-75-F-01-8073. 105p. Dep. NTIS, PC A06/MF A01.

The Los Angeles Senior Citizen Lifeline Rate, introduced in November 1975, is examined. The program covers over 89,000 homes in which the household head is at least 62 years of age and combined adjusted household income does not exceed $7500 per year. The lifeline rate offers eligible households a 50% discount on their first 360 kWh of bimonthly consumption. At current prices, each household's discount averages $10 every two months. The rates on all other consumption were raised 1.8% to finance these discounts. The chief objectives of an economic assistance plan targeted at low-income senior citizens should be (1) to improve the economic well-being of senior citizens and (2) to promote efficient use of resources. To assess this particular lifeline rate, this study compares it with two possible alternative plans - direct cash transfers to low-income senior citizens, and an electricity stamp program - on the criteria of program administration costs, ease of participation by the eligible, and resource efficiency measured by changes in consumption. This report calculates the efficiency losses arising from the new consumption caused by the lifeline price discount and compares them with the efficiency gains arising from the discouragement of new consumption via the price increases that finance the lifeline rate. Over the probable ranges of price responsiveness and costs of new production, efficiency gains outweigh efficiency losses. This report performs a general statistical analysis of lifeline consumption patterns. It finds: many of the lifeline households consume very small amounts of electricity, small-quantity consumers of electricity do not necessarily have low incomes, and low income consumers do not necessarily use small quantities of electricity.

38933 **Time series forecasting of utility load duration curves.** Maybee, S. (Univ. of Colorado, Boulder); Uri, N.D. *Can. Electr. Eng. J.;* **4**: No. 1, 4-8(Jan 1979).

The load duration curve is a primary tool used in the economic analysis of electric utility operations and for the purpose of planning new construction. In general equilibrium models and also in other models using linear programming, piecewise linear approximations to the load duration curve are required. A forecasting model for such discrete approximations is developed using Box—Jenkins time series analysis. A model is structured and estimated for six, twenty, and fifty discrete approximations for two electric utility regions in the United States. The forecast results are extremely good, indicating that while a larger number of approximations perform marginally better, there is nothing to lessen the advantage of using only a six-step approximation.

38934 **Role of a private utility in production of energy.** Satre, W.J. pp 21-24 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Electric utilities need to adopt the can do approach private industry uses to solve problems: an approach that recognizes the value of the profit system and the importance of efficient decision making while accepting the responsibility for providing reliable service. Utilities and government need to change their adversary stance to one of cooperation in facing the problems of increased demand and finding a more acceptable way to resolve the environmental and social costs of new generating capacity than uncontrolled intervention. The choice now is whether to remove obstacles and continue the utilities' traditional role of supplying energy or to turn the power supply role over to the Federal bureaucracy.

38935 **Need for better forecasting.** Butcher, W.R. (Washington State Univ., Pullman). pp 45-50 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Forecasting electricity demand is becoming an increasingly sophisticated and controversial art, indicating that a better method is needed. Four principles are suggested to improve projections: disaggregating demand, combining the number of units using electricity and the estimates per unit, allowing for demand changes caused by economic variables, and using good data and analytical techniques. The links between self-fulfilling forecasts and actual demand need to be removed and utility planners need to consider which growth, pricing, and conservation policies are in the public's best interest.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 38327, 38330, 38331, 38338, 38340, 38342, 38344, 38345, 38590, 38591, 39039

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

38936 (PB—285827) **Electric utility financial problems and potential solutions. Summary report.** Kahn, M.H. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1976. 78p. NTIS PC A05/MF A01.

This report summarizes presentations by representatives of utilities and financial institutions, state and federal regulators, and researchers. Various means of improving utilities' capital accumulation picture were considered, such as including construction works in progress in the rate base, although the basic problem, it was agreed, is assuring a price that covers the costs of production. Pricing structures that account for peak responsibility need more attention. Research on price elasticities of demand and effects of peak load pricing on capital, energy and revenue requirements is vital. The entire regulatory process also warrants attention, especially the treatment of price structure and financial structure, the geographic variations in price and regulation, and the timely responsiveness of hearings. Questions were also raised as to the optimum size and structure of individual utilities and the entire industry.

38937 **Electrical load management: the British experience. Part II.** Platts, J. (Electricity Council, London, England). *IEEE Spectrum;* **16**: No. 4, 66-68(Apr 1979).

Twenty years of load management experience in three British utility systems report successful leveling of demand curves. The success is attributed to (1) time-based controls installed on the customer's premises and the use of twin dial meters to record peak and mid-peak kilowatt hours; (2) weather-sensitive controls that regulate the amount of heat stored by space and waterheating equipment; (3) line-voltage signaling. British utilities plan to continue refining thermal-storage techniques for space and water heating in both residential and commercial buildings. A swing to electroproduction methods in industry, increased use of battery-powered electric vehicles in factory areas, and a trend toward more nuclear

electrical-generating capacity will give added impetus to the use of off-peak electricity.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 38862, 39003, 39007, 39030

38938 (PB—284018) **An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974—30 June 1977.** Seila, A.F.; Entsminger, M.A.; Silva, C.Z. (North Carolina Univ., Chapel Hill (USA). Highway Safety Research Center). 30 Jun 1977. Contract DOT-HS-4-00897. 215p. NTIS PC A10/MF A01.

Because of the energy crisis of early 1974 and the resulting measures (both voluntary and mandatory) to conserve fuel supplies, there were dramatic changes in both the highway environment and accident scene. This report examines North Carolina data on vehicle mileage, traffic volumes, accident frequencies and severity, crash rates, and driver characteristics in an effort to derive some insight into the nature of the changes that occurred, and to specifically identify those factors that may have had a significant influence on the lower number of fatal accidents. Most of the analyses involve a comparison of data for the first four months of 1973, 1974, and 1975. Where trends have been in effect for several years, certain variables such as overall vehicle mileage and accident rates are examined using techniques from time series analysis.

38939 **Energy use in the production of primary aluminum.** Boercker, S.W. (Oak Ridge Associated Universities Inc., TN). *Mater. Soc.;* 3: No. 2, 153-161(1979).

An overview of the aluminum industry is followed by an energy analysis of the processes used in the production of primary aluminum from bauxite. Calcining of alumina at about 1150°C, electrolytic reduction of alumina to aluminum metal (~ 950°C) requiring about 15,600 kWh/ton Al, and anode baking at 1100°C are identified as the most-demanding processes. This analysis shows that present technology requires an average of over 16,000 kWh of electricity and 90 x 10^6 Btu of thermal energy, including fuel equivalents of anodes and cathodes consumed in the process, to produce one ton of aluminum ingot from bauxite. Also discussed are the alternative sources of aluminum, such as clays; the possibilities for energy conservation, such as recycling and the Alcoa chloride cell; and the dependence of the U.S. aluminum industry on imports. 21 references.

38940 **Energy in new housing: economic and technical aspects of alternative sources of supply.** Peet, N.J.; Henderson, C.F.; Hobbs, S.H. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1978). 67p. (NZERDC—38).

Economic and technical factors relevant to a study of alternative means of supplying energy to new residential housing in New Zealand over the next 10 to 15 years are evaluated. Christchurch was used as the basis for detailed examination of certain supply situations, but the results should be valid for most urban areas in this country. Annual energy demands were estimated for a typical insulated NZ house over the range of climatic zones from Auckland to Invercargill. The main economic and technical factors that affect the average householder's choice of an energy system are initial capital cost, continuing cost of fuel, and efficiency of in-house appliances used for cooking, water heating, and space heating. The all-electric or all-natural-gas house energy systems are the cheapest to install and the total annual costs to the householder (including capital charges and fuel) are generally lowest with natural gas, although at modest levels of space heating the difference between gas and electricity is relatively small. Electric storage heaters show little advantage over direct electric heating. Approved coal-fired space heaters give total annual costs a little lower than electric heating, for high space heating requirements, but cost more for low heating requirements. Open fires and oil-fired heating are relatively expensive. The very high price of manufactured gas makes this form of energy uneconomical for the householder.

38941 **Energy in transport. Volume 1. Data.** Auckland, New Zealand; New Zealand Energy Research and Development Committee (1977). 58p. (NZERDC—27(Vol.1)).

Detailed information on energy use in New Zealand transport together with international comparisons and historical trends is presented. The terms of reference of the study directed efforts to quantifying direct energy use (energy supplied for vehicle propulsion) and indirect energy consumption, i.e., energy used in producing and maintaining vehicles, transport infrastructure, and fuels, is not analyzed in detail. The data tabulations are for whole transport systems and global data have been used as control totals. Data are detailed in 6 chapters: rail, sea, and air transport; private cate car; goods service vehicles; buses; taxis, rental cars, motorcycles, and powercycles; and cycling and walking. (MCW)

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 38325, 38510, 38877, 38890

SOLAR

REFER ALSO TO CITATION(S) 38352, 38353, 38360, 38361, 38362, 38363, 38364, 38365, 38367, 38368, 38369, 38377, 38420, 38468, 38912

GEOTHERMAL

REFER ALSO TO CITATION(S) 38528

OTHER

REFER ALSO TO CITATION(S) 38326, 38399, 38563

38942 (PB—285566) **Fusion power development issues. Final report.** Denning, R.S.; Waddell, J.D.; Triplett, M.B.; Kok, K.D.; Willke, T.L. (Battelle Columbus Labs., OH (USA)). 31 Aug 1977. Contract NSF-PRA76-23771. 61p. NTIS PC A04/MF A01.

Propriety of the optimistic goal of an operating fusion demonstration by the year 2000 depends on when exhaustible energy sources will be depleted and on the ability of breeder fission reactors to overcome socio-political hurdles. The risk of an energy shortage near the end of the first quarter of the next century appears significant enough that an early goal for fusion demonstration is appropriate. Such a goal places considerable emphasis on tokamak development and forces the development strategy into a normative form. If less urgency were placed on achieving demonstration, the fusion program could be more exploratory and therefore more likely to develop economically viable devices with commercial characteristics preferable to our present conceptualization of tokomaks. Greater emphasis should be placed on hybrid reactors as alternatives to fission breeder reactors; they have many of the same perceived evils as fission reactors, however. Conventional cost-benefit analyses underestimate benefits of long-term energy resources such as fusion and solar power. Risk and uncertainty and discount rates reflecting social concerns for the future should be considered in these analyses.

ENERGY CONVERSION

38943 (AD-A—059384) **Direct energy conversion devices and their potential naval applications. Final report 1 jul-15 oct 76.** Wu, C. (Naval Academy, Annapolis, MD (USA). Environmental Protection Research and Development Team). Oct 1976. 36p. NTIS PC A03/MF A01.

Direct energy conversion devices may be used as prime movers, refrigerating machines, etc. and are endowed with characteristics well suited to diverse naval applications. Despite this, not much effort has been invested in the U.S. Navy in their development. There is a real and urgent need for the initiation of substantial fundamental work in this area. Developments of thermoelectric converters, thermionic generators, photovoltaic cells, MHD systems and fuel cells are surveyed. A comparison between conventional energy conversion and direct energy conversion in size, weight, and efficiency is made. Potential utilization of these direct conversion devices to our Navy is studied. (Author)

MHD GENERATORS

38944 (CONF-781009—) **US—USSR colloquium on magnetohydrodynamic electrical power generation.** (Department of Energy, Washington, DC (USA). Div. of Magnetohydrodynamics). 1978. 889p. Dep. NTIS, PC A99/MF A01.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Separate abstracts were prepared for the 30 papers presented. (WHK)

38945 (CONF-781009—, pp 85-104) **Development of the MHD method of energy conversion in the U.S.S.R.** Sheindlin, A.E.; Pishchikov, S.I.; Shumiatsky, B.Y.; Maslennikov, V.M.; Morozov, G.N. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

A historical review of the development of MHD generators in the USSR is presented. The U-02 and U-25 generators are briefly

described and plans for building commercial-scale natural gas-fired MHD power plants are discussed. Air pollution control and the economics of combined cycle MHD/steam power plants are discussed. (WHK)

38946 (CONF-781009—, pp 105-116) **Open cycle coal fired MHD plants as part of the electric utility system.** Retallick, F.D.; Lippert, T.E.; McCutchan, D.A. (Westinghouse Electric Corp., Pittsburgh, PA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

A magnetohydrodynamic (MHD)/steam combined cycle power plant must ultimately be capable of fitting into a utility system and competing economically with other power plants. Power plant reliability and availability become significantly important plant parameters. The basis for this analysis is a computer simulation which models the dynamics and interactions of an expanding power generation system. The model provides an economically optimal expansion plan that meets the system's load growth requirements and simulates the planning decision process of the utility. Specifically, the program will expand the system to maintain specified system reliability in terms of loss of load probability or percent reserve, observing committed unit additions and retirements. It performs an evaluation of production cost impact of plant installation decisions as well as determining economically optimum dispatching of power plants with consideration of both forced outages and scheduled maintenance. Using this simulation, open cycle MHD (OCMHD) has been examined in order to better understand the requirements a utility system might impose on plant design as well as to identify favorable attributes of the plant that would enhance the overall system generation performance. The study period is taken from 1985 through the year 2005. Results are presented and discussed.

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 38952, 38954, 38977

38947 (CONF-781009—, pp 129-160) **Influence of component redundancy on the availability of open cycle MHD power plants.** Cutting, J.C. (Gilbert Associates, Inc., Reading, PA); DelBueno, R.P.; Eckels, R.; Maruvada, S.N.; Chamow, M.F.; Lynch, J.J. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

This paper describes a continuing effort to identify methods of improving availability/reliability of open cycle MHD power plants. Analytical and design studies have been performed which indicate that the use of redundant MHD topping cycle equipment can result in significant improvement in plant availability and/or reduced MTBF requirements for channels and combustors. Design considerations for rapid component replacement/repair have been incorporated into the study and a safety analysis is presently underway. Final results of the study will include an assessment of the impact of these cycle or equipment arrangements upon the commercialization of open cycle MHD.

38948 (CONF-781009—, pp 383-410) **Combustion gas disk generator studies.** Louis, J.F.; Loubsky, W.J. (Massachusetts Inst. of Tech., Cambridge). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The open-cycle disk generator work at MIT is summarized. The program emphasizes an integrated theoretical and experimental approach to the development of a data base for disk generators, both with respect to plasma properties and channel performance. Critical factors which influence the performance are identified and discussed. Specific program goals are given, and the current status of the work is reported; recent results and analysis of performance tests with swirl, nonuniformities studies and diagnostic development are reviewed. Future work is mentioned.

38949 (CONF-781009—, pp 411-414) **Open-cycle disk generator studies.** Klepeis, J.E. (Dynatrend, Inc., Burlington, MA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The subjects of disk unit-size and mode of operation, compared to linear channels, are briefly discussed. Only radial inlet flow disks are considered. It is suggested that: (a) disk unit size, for the same enthalpy extraction, can be within a factor of two of that of linear channels, and (b) the usually mentioned surface-to-volume disadvantage of the disk is not a relevant consideration since it is the absolute channel surface area that is important. As regards the latter, disk surface area can be about equal to that of a comparably performing linear channel, with lower heat transfer and friction losses for the disk.

38950 (CONF-781009—, pp 471-482) **Coal-fired MHD power generation: including balance of plant.** Dicks, J.B. (Univ. of Tennessee Space Inst., Tullahoma); Strom, S.S.; Markant, H.P.; Probert, P.B. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Significant advancements in the development of coal-fired MHD power plants have occurred in recent years. These advancements have been primarily keyed to the development of a satisfactory coal-fired MHD generator. More recently, accelerated efforts have been placed on the development of technology and engineering data on the bottoming cycle of an overall power plant. The total concept being developed by both the University of Tennessee Space Institute and the Babcock and Wilcox Company under contract to the Department of Energy is described. Proof of the concept and further development needs will be experimentally demonstrated at The University of Tennessee test site located in Tullahoma, Tennessee.

38951 (FE—2524-8, pp 155-161) **Water quality/biological surveillance program for CDIF support .** Portch, R.; Cornish, J. 1978.

In MHD power generation: research, development and engineering. Quarterly progress report, January—March 1978.

The water quality/biological surveillance program progressed with the prescribed water quality sampling and analytical schedule. Sampling sites for biological monitoring have been identified tentatively, and site acquiaition procedures have been initiated. Data reduction will proceed as soon as computer support is provided.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 38974, 38975, 38976

38952 (CONF-781009—, pp 3-23) **Capabilities and test program for the component development and integration facility and the coal fired flow facility.** Lightner, R.G.; Epstein, J. (Department of Energy, Washington, DC). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

When construction is completed, the Component Development and Integration Facility (CDIF) will provide a flexible test bed for engineering scale MHD power train components at a total power input of 50 MW thermal. The testing program at the CDIF is directed towards obtaining data to verify results obtained in smaller scale laboratory tests, proving the capability of components to function during sustained operation and demonstrating the performance of groups of components integrated to form power train systems. The DOE—CFFF is a development facility at the 20 MWt level for developing and testing MHD concepts in total slag carry over, heat recovery-seed recovery, environmental monitoring and control, and other DOE supplied hardware. The facility complements the CDIF and will provide the data required for designing components at the next higher megawatt level (CDIF or ETF) or discarding concepts that do not have either practical technical or temporal merit. It will help focus the MHD program into a timely and practical path and defer or cancel effort proved to be non productive - feasible but not practical - or untimely. The facilities are described and the capabilities and test programs are outlined. (WHK)

38953 (CONF-781009—, pp 25-58) **Results of the first phase tests of the U-25B facility.** Sheindlin, A.E. (Inst. of High Temperatures, Moscow, USSR); Iserov, A.D.; Maksimenko, V.I. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The USSR has designed and fabricated a large MHD facility which used as its base the equipment of the existing USSR U-25 facility. The new facility was named U-25B. For its part the USA designed, fabricated, and delivered to the U-25B facility a superconducting magnet system with a magnetic field induction up to 5 T. Installation of the U-25B facility and superconducting magnetic system was completed at the end of 1977. In December of 1977, the shakedown of the facility was carried out successfully. Shakedown tests have shown that all the components and systems of the facility performed well. Hot tests (i.e. with the combustor in operation) were continued for more than 10 hr. The open circuit voltage was about 800 v, B = 2 T and the mass flow about 2 kg/s during this first operation. Test 2 in the facility was completed in March 1978. The basic purpose of this test was to study the performance of all the components and the systems of the U-25B test unit when the

magnetic field was increased to its maximum level of 5 T and when the combustion gas mass flow rate was increased to 3.2 kg/sec. At these conditions the electric power from the MHD generator was 242 kW, the load voltage 2 to 2.5 kV, the current was about 100 amps. With the combustor operation optimuized, electrical field was about 1 kv per meter. The results of the first phase of experiments in the U-25B facility (Test 1 and Test 2) are described. Some preliminary results of the third test are also given. The maximum power of the MHD generator was 575 kilowatts, the maximum operational voltage 4.24 kV, corresponding to an electrical field up to 2.1 kV per meter. The duration of the hot tests for Test 3 was about 15 hrs.

38954 (CONF-781009—, pp 117-128) **Studies at the U-25 MHD pilot plant, 1977—1978.** Pishchikov, S.I.; Sokol'sky, A.G.; Pinkhasik, M.S. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Activities connected with MHD channel were mainly directed towards the solution of the following problems: (1) the study of electrode and insulation materials and the development of designs for various types of electrodes and intermodular gaps; (2) selection of optimum schemes for electrical loading and inversion for transforming direct current into alternating current; (3) design development to improve water cooling of the channel; and (4) improvement of quality and methods of electrical insulation control. Studies of combustion chambers to ensure long-duration operation, improved seed recovery, and cleaning of the steam generator are also discussed. (WHK)

38955 (CONF-781009—, pp 161-217) **Numerical modeling of MHD generator operation in an MHD power plant operating at part load.** Bitiurin, V.A.; Ivanov, P.P.; Koriagina, G.M.; Liubimov, G.A.; Maslennikov, G.I.; Medin, S.A.; Morozov, G.N.; Prokop, A.S. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

One of the most important requirements of electrical power generation is the need to ensure the most economical part-load operation. When developing new high output generating units, including units with MHD generators, it must be remembered that they will need to operate on the variable portion of the electrical load demand curve. A study of part-load operation of an MHD power plant using as an example the first MHD power plant is presented. The main components of this plant are: compressor, separately fired air preheater, combustion chamber, MHD generator and steam turbine facility. When studying part operating modes, use is made of the individual characteristics of MHD power plant components as a function of the load (the so-called power generating characteristics). These serve as the basis for the pre-conceptual design of the equipment for the first MHD power plant, MHDES-500. At the same time, for the standard components, data available in the literature and operating experience of gas turbine and steam turbine power plants have been used with appropriate modifications for the special operating requirements of an MHD power plant

38956 **Experimental investigation on a direct coal-fired MHD generator.** Wu, Y.C.L.; Dicks, J.B.; Muehlhauser, J.W.; Scott, M.H.; Kroeger, G.; My, T. (Univ. of Tennessee Space Inst., Tullahoma). pp IV.6.1-IV.6.7 of Engineering aspects of magnetohydrodynamics. Zauderer, B. (ed.). University, MS; Univ. of Mississippi (1976).

From 15. symposium on the engineering aspects of magnetohydrodynamics; Philadelphia, PA, USA (24 May 1976).

A number of experiments of the UTSI direct coal-fired 60° diagonal conducting wall (DCW) generator are described. Results presented include a study of the behavior of individual electrodes, the effect of cermet coating on the electrode, the overall performance of the generator when operating in the multiple load mode and a current distribution study. The aim of these experiments is to gain further understanding of the direct coal-fired DCW generators so that improved performance can be made.

38957 (FE—1760-29) **Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April—June 1977.** Dicks, J.B. Jr.; Markant, H.P.; Beaton, M.S. (Tennessee Univ., Tullahoma (USA). Space Inst.). 15 Jul 1977. Contract EX-76-C-01-1760. 52p. Dep. NTIS, PC A04/MF A01.

Tests conducted in the existing MHD facility were concentrated in areas critical to the design of components for the new intermediate-size, direct coal-fired MHD test facility. Tests in the area of slag/seed separation and seed recovery were begun for the purpose of evaluating a seed condensing unit for potassium sulfate recovery and a commerical bagfilter as a second stage collection device. Generator and applied-field tests were conducted to evaluate the performance of candidate insulator materials and a series of tests were begun to evaluate combustor performance for a newly designed water-cooled injector and various coal dispersers. Further construction bid packages were defined to facilitate the completion of the new MHD facility.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 38950, 38978, 38979, 38980, 38981, 38982

38958 (CONF-780952—24) **Observation of voltage fluctuations in a superconducting magnet during MHD power generation.** Smith, R.P.; Niemann, R.C.; Kraimer, M.R.; Zinneman, T.E. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 5p. Dep. NTIS, MF A01.

From Applied superconductivity conference; Pittsburgh, PA, USA (25 Sep 1978).

Portions of document are illegible.

Fluctuating voltage signals on the potential taps of the ANL 5.0 T MHD Superconducting Dipole Magnet have been observed during MHD power generation at the U-25B Facility at the High Temperature Institute (IVTAN) Moscow, USSR. Various other thermodynamic and electrical parameters of the U-25B flow train have been recorded, and statistical analysis concerning correlations between the phenomena with a view of discerning causal interdependence is in progress. Voltage fluctuations observed at the magnet terminals are analyzed with special emphasis on magnet stability.

38959 (CONF-781009—, pp 417-438) **Status of air heater development in the United States for MHD systems.** White, L.R. (Fluidyne Engineering Corp., Minneapolis, MN); DeCoursin, D.G.; Postlethwaite, A.W. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Air heater work throughout the United States is reviewed within the framework of three different MHD system configurations: directly-fired, indirectly-fired with a dirty fuel, and indirectly-fired with a clean fuel. Each system presents different technical problems which interact with those of the power train to give a range of technical risk and system efficiency. Directly-fired systems are covered first followed by indirectly-fired systems with either clean or dirty fuels. Finally, work related to heaters such as valve testing is discussed along with latest developments in hot blast stoves used in the steel industry. 26 references.

38960 (CONF-781009—, pp 439-470) **Combustion chambers for MHD power plants.** Maslennikov, V.M.; Tager, S.A.; Sukhov, V.N.; Rotinov, A.G.; Miniaev, N.A.; Granovsky, E.A.; Kniga, A.A.; Kalmaru, A.M.; Talumaa, R.U. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The design, operation, and characteristics of combustion chambers for natural gas, fuel oils, and coals for use with MHD generators are discussed. Parameter optimization, methods for nitrogen oxide suppression, and slagging in coal combustion chambers are considered. (WHK)

38961 (CONF-781009—, pp 485-500) **High temperature air preheaters for a commercial scale MHD power plant.** Volovik, A.V.; Britvin, A.I.; Zaichenko, V.M. (Inst. of High Temperature, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

A state-of-the-art review of high-temperature air preheaters for commercial scale MHD power plants is presented. The air preheaters are an essential power plant component, using between 30 and 40% of the total fuel consumed by the power plant. The heat source for air preheaters of a commercial scale MHD power plant may be combustion products of clean natural gas, liquid or solid fuel, or the exhausted combustion products from the MHD generator. For the first generation MHD power plant, it is feasible to consider preheaters operating on natural gas, since its clean combustion products significantly simplify operating conditions for materials in the high temperature zone of air preheaters. The most acceptable principle for the commercial scale MHD power plant oxidizer is the regenerative method with separately fired preheaters having a fixed matrix operating alternately in heating and cooling modes. Preheating with exhaust gases of the MHD generator will require materials for the matrix capable of operating in high temperature zones of air preheaters in the presence of seed in the heating gas and, when operating with solid fuel, in the presence of ash, as well.

38962 (CONF-781009—, pp 501-540) **MHD downstream gas management.** Johnson, T.R.; Im, K.H.; Chow, L.S.H.; Blackburn, P.E.; Singh, R. (Argonne National Lab., IL). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The components of the steam generator system downstream of the MHD channel are similar in most respects to the steam generator components in a conventional coal-fired power plant, but there are important differences that must be considered in their design. These differences arise both from the additional requirements placed on the MHD downstream gas system and from the more severe operating conditions. In addition to the efficient production of steam and removal of pollutants from the exhaust gases, the MHD system must preheat combustion air to as high a temperature as practical and must recover nearly all of the potassium for recycle. The downstream system must perform reliably with an inlet gas stream that is hotter than the combustion gas in conventional plants, is fuel-rich, has a larger number of submicron slag particles, and contains larger amounts of NO/sub x/ and vaporized alkali-metal compounds. The design of radiant boilers, steam heaters, and air heaters are discussed including materials aspects. Also, seed-slag chemistry is discussed. (WHK)

38963 (CONF-781009—, pp 603-634) **Discharge and corrosion characteristics of slagging metal electrodes.** Koester, J.K. (Stanford Univ., CA); Perkins, R.A. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The behavior of slag coated electrodes under applied transverse discharges at MHD generator duct conditions was investigated for various metal electrodes and two different coals. The critical current density for diffuse mode operation was an order of magnitude larger for iron (1018 steel) than for stainless steel or nickel electrodes. The erosion rate was larger for iron anodes, but negligible for iron cathodes. Slag layers were found to have substantial ionic conductivity with iron and potassium as the mobile species. Severe anodic polarization was observed for all materials other than low carbon steel. The plating out of iron in the slag layer was observed at the cathode wall. Similar effects were observed in a slag electrochemical cell. This test was used to screen several electrode materials, including both active and noble metals. The polarization effects were orders of magnitude more severe for the nobel materials.

38964 (CONF-781009—, pp 715-728) **Development of a technique for measurement of electrical conductivity of plasma in MHD generator channels.** Gaponov, I.M.; Kruglyi, S.I.; Mikhailov, Yu.S.; Nefedov, A.P.; Oberman, F.M. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

A promising system for measuring the electrical conductivity and velocity of the plasma flow in MHD generators consists of a primary and several secondary coils. ac current through the primary coil generates an oscillating dipole magnetic field in the plasma. The secondary coils responds to the field perturbation caused by the presence and motion of the conducting medium. The signals from the secondary coils are proportional to the electrical conductivity and the product of electrical conductivity with plasma velocity. The development and testing of a three-coil sensor and an electronic recording scheme are described.

38965 (CONF-781009—, pp 731-747) **Spectroscopic measurements of temperature, electron density, and temperature fluctuations.** Kruger, C.H.; Kowalik, R.M.; James, R.K. (Stanford Univ., CA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Spectroscopic diagnostics developed at Stanford to measure the temperature and electron density of MHD generator plasmas with spatial and time resolution is discussed. Line of sight methods have been used to obtain profiles of temperature and electron number density in the electrode wall boundary layer. A generalization of the sodium line reversal technique is used to obtain the temperature and the absolute emission intensity from high lying electronic levels of the potassium seed atoms yields the electron density. Optimization of the optical design for high spatial resolution, plus computer based signal processing techniques for noise reduction have enabled spatial resolution of 0.3 mm with measurements typically within 0.4 mm of the electrode wall. For the temperature measurement, direct time resolution is possible since a mechanical chopper between the calibrated tungsten strip lamp and the plasma provide alternating values of plasma emission only and emissions plus lamp transmission. As an alternative procedure, a theory was developed which relates RMS temperature fluctuations to RMS radiation intensity fluctuations in a generalized line reversal procedure. The method has been applied to obtain the magnitude of temperature fluctuations in a laboratory burner modified to obtain regular periodic disturbances, and also in an MHD channel. In addition to these line of sight methods, the feasibilty of a laser fluorescence technique to obtain local relative and time resolved temperature measurements was recently demonstrated. This fluorescence technique involves the use of a tunable dye laser to pump transitions from an excited electronic level of sodium or potassium to a higher level.

38966 (CONF-781009—, pp 825-847) **Techniques for measurement of ash droplet size in coal-fired MHD flows.** Ariessohn, P.; Holve, D.; Self, S.A. (Stanford Univ., CA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

In coal-fired MHD flows, a knowledge of the ash particulate concentration and size distribution is important for several reasons. Past and ongoing experiments to measure the ash concentration and size distribution in such flows are reported. Because the problems of using sampling probes to capture high velocity, high temperature liquid droplets are formidable, our attention has focused on nonintrusive optical techniques. The simplest of these is the transmissometer which measures the extinction of a collimated light beam resulting from scattering and absorption by the particles. This is a well-established technique for cold flows, which effectively yields a measure of the total projected area of all the particles in the beam. To deduce a mean particle diameter, a separate measure is required of the fractional loading of ash. A two-pass transmissometer, employing a He—Ne laser ($\lambda = 632.8$ nm) has been used to measure the average particle size in the plasma issuing from a channel (5 x 10 cm) attached to the M-8 combustor fired with a slurry of pulverized coal in ethanol, at input ash mass fractions of $\sim 0.50\%$. A new two-wavelength laser transmissometer system is being constructed, which should allow the measurement of smaller extinction values. By using two widely separated wavelengths, it is possible to determine the mean particle size and ash loading. In separate work, a laser scattering device has been developed which determines the particle size distribution from the amplitude distribution of scattered light pulses as individual particles pass through the focus of a laser beam. At present this system is capable of in-situ measurements for particle diameters in the range 2 to 30 μm in low velocity flames.

38967 (CONF-7805142—1) **Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2.** Telegin, G.P.; Romanov, A.I.; Rekov, A.I.; Spiridonov, E.G.; Barodina, T.I.; Vysotsky, D.A. (Department of Energy, Washington, DC (USA). Div. of Magnetohydrodynamics; AN SSSR, Moscow. Inst. Vysokikh Temperatur). Oct 1978. 40p. Dep. NTIS, PC A03/MF A01.

From US-USSR cooperative program in MHD power generation; Gaithersburg, MD, USA (24 May 1978).

In accordance with the overall program of the US—USSR cooperation in the field of MHD power generation tests of Soviet electrode materials were conducted at the coal burning MHD facility UTSI-2 of the University of Tennessee Space Institute. The main purposes of the tests are evaluation of electrode materials behavior in the channel of the MHD generator operating with combustion products of coal containing ionizing alkali seed, study of thermal and physical stability of materials in the presence of corrosive slag, study of electrophysical characteristics of electrode materials when they are subjected to the passage of current through the plasma-slag-electrode system. Tests were conducted on electrodes made of silicon carbide doped with titanium and $LaCrO_3$—Cr cermet. Results are reported on the phase and chemical composition and structure of these two materials, their thermophysical and electrophysical properties, and the electrode fabrication methods. The MHD facility UTSI-2, where the tests were conducted is one of few utilizing actual coal as the fuel. A description of this facility is given, and its main operating parameters and the methods used to conduct electrode tests with and without an applied current are described.

38968 **Fuels and combustion.** Joubert, J.I.; Tager, S.A. pp 391-464 of Open-cycle magnetohydrodynamic electrical power generation. Petrick, M.; Shumyatskii, B.Ya. (eds.). Argonne, IL; Argonne National Laboratory (1978).

A comprehensive review of design requirements and the state-of-the-art of fossil-fuel combustors for MHD generators is presented. Design requirements for MHD combustors, fuel and thermodynamic considerations, combustor design factors, the effect of ash on combustor operation, experimental MHD combustors, and commercial-scale combustors are discussed. 82 references. (WHK)

38969 (INIS-mf—4506, pp v) **Assessment of cracks for elastoplastic material behavior.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Values of the stress intensity factor K, the crack tip opening stretch COS and the energy integral J were determined with the

purpose of describing the strength and fracure of cracked components in the elasto-plastic regime of material behavior. Essentially two modifications of the steel 22 NiMoCr 37 were investigated; the test temperature was 298°K; compact (C) specimens and single edge notched (SEN) tension specimens of thicknesses 10 to 75 mm with different crack lengths were tested. For the material, geometry and loading conditions investigated values of COS were determined in an exact and reproducible way by direct optical measurement at the specimen surface. At the same time these values could be inferred from a single clip gage displacement measurement at the open end of the specimen on the basis of a plastic hinge mechanism with a load dependent center of rotation. As compared to other existing models a description is achieved which is the same and conservative over the whole load range for all thicknesses and crack lengths of one type of specimen.

38970 (MIT—2295-1) **Superconducting magnetohydrodynamic magnet development program, Phase I. Quarterly technical progress report No. 6, October 1—December 31, 1977.** Williams, J.E.C. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). Feb 1978. Contract EX-77-A-01-2295. 43p. Dep. NTIS, PC A03/MF A01.

The status of composite conductor stability studies, the design of the base-load magnet structure, the status of the component test facility, research and development on forced-flow cooled superconductors, and external contracts are reported. (WHK)

38971 (PNL—2738) **Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test.** Marchant, D.D.; Bates, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 128p. Dep. NTIS, PC A07/MF A01.

As part of a cooperative U.S.—U.S.S.R. program, electrode and insulator materials tested at the Westinghouse Electrode Systems Test Facility in Pittsburgh, Pennsylvania, were evaluated. From this evaluation materials will be selected for use in the third phase of tests being conducted in the U-02 magnetohydrodynamics test facility in the Soviet Union. Electrode and insulator materials were examined with both an optical microscope and a scanning electron microscope. The cathodes were found to behave differently from the anodes; most notably, the cathodes showed greater potassium interaction. The lanthanum chromite-based electrodes (excluding those fabricated by plasma-spraying) are recommended for testing in the U-02 Phase III test. Hotpressed, fused-grained MgO and sintered $MgAl_2O_4$ are recommended as insulator materials. The electrode attachment techniques used in the Westinghouse Tests were inadequate and need to be modified for the U-02 test.

38972 High temperature materials requirements of the magnetohydrodynamic energy conversion. Anthony, A.M. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Centre de Recherches sur la Physique des Hautes Temperatures). pp 230-236 of Advanced high temperature materials: technological and industrial aspects. Kroeckel, H. (ed.). Paris, France; Masson (1977).

From 1. colloquium on advanced high temperature materials; Petten, Netherlands (29 Jan 1976).

After a brief survey of electrical power generation by MHD, high temperature materials are examined. Properties required are high melting point, low vapour pressure, high resistance to abrasion, to corrosion, to thermal shock and moreover electrical conductivity should be low for insulating walls and high for electrodes with high thermoelectronic emission. Use of MgO, ThO_2, BeO, Al_2O_3 or zirconates as insulating materials is discussed. For electrodes alloys are not promising at high temperature and have poor oxidation resistance, carbides or borides are promising but oxidation is too large at high temperature. Oxide ceramics are examined zirconia needs stabilization, $LaCrO_3$ has poor orrosion resistance, some interesting results are obtained on $FeAl_2O_4$-Fe_3O_4 solid solutions. Hot channel operation tests do not yet reach the 1,000 hours life limit and for practical use continuous operation of the order of 10,000 hours would be needed.

DUCT ENGINEERING AND FLUID DYNAMICS

38973 (CONF-781009—, pp 222-246) **Design of a single output MHD generator for the USSR U-25 installation.** Brogan, T.R.; Hill, J.A.; Goff, R.M.; Diatchenko, N. (MEPPSCO, Inc., Boston, MA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

An MHD generator designed and constructed in the US will be evaluated at the USSR U-25 Facility as a part of the US—USSR Cooperative MHD Program. A description of the final design of that generator is given. The generator, with a mass flow of 50 kg/sec and thermal flux of 280 MW, is approximately of ETF scale. Maximum combustion pressure is 3.2 atm abs at 2600C combustion temperature. The magnetic field is 2T, natural gas is the fuel, and potassium is the seed. The generator design is compatible with the constraints of the already existing U-25 Facility. It is of bolted, rectangular, windowframe DCW construction. The 0.95 cm frame thickness leads to a maximum interframe potential of less than 15 volts. Because of the modest enthalpy extraction at the U-25 due to the 2T field level, the gas conductivity change through the channel is small so that the generator is designed for two terminal output. A novel diode current consolidation network positions the power takeoff at inlet and outlet at the point of electric field reversal in the fringe fields, thus avoiding current and field singularities. Power takeoff is also facilitated by the use of shallower frame angle in the finge field as compared to the 45° angle in the central portion of the channel. Design output is 2840 amperes at 4000 volts to a single output inverter system especially prepared for the generator by the USSR side. The generator is designed to utilize an accelerating subsonic flow with the sonic point located well within the field in order to provide adequate length for effective diffusion while mating with the U-25 steam generator.

38974 (CONF-781009—, pp 247-269) **Study of the influence of a slag film on the characteristics of electrodes in the MHD generator channel of the U-02 facility.** Burenkov, D.K.; Dalinsky, Yu.L.; Zalkind, V.I.; Zamyslov, O.B.; Strekalov, N.V.; Tikhotsky, A.S.; Uspenskaya, G.L. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Near electrode processes at the walls of the MHD generator channel, to a large extent, determine the service life, the electrical characteristics and the dielectric strength of the entire channel. The presence of a slag film on the electrode wall surfaces in an MHD generator channel considerably complicates the mechanism of current flow from the plasma, through the slag film to the electrode material. On one hand, the presence of a slag film with an approximately constant surface temperature having little dependence on the temperature of the electrode itself leads to a uniform character of discharges on the surface of the film and an improvement of cold metal electrode characteristics. On the other hand, the very sharp dependence of electrical conductivity of slags on temperature and its predominantly ionic character influence arc formation on its surface, and cause the appearance of current nonuniformities and electrode erosion. In order to understand the processes occurring under these conditions, it is desirable to vary the main experimental parameters, in particular, the temperature of the electrode surface, and to utilize a sufficiently detailed diagnostics of both the film itself and the related current effects. Such studies were performed in the U-02 facility under simulated coal-fired conditions. Slag film behavior, its influence on the characteristics of electrodes, and near electrode phenomena were studied. Results are reported and discussed. (WHK)

38975 (CONF-781009—, pp 271-346) **Channel development for coal fired MHD.** Cole, J.; Demirjian, A.; Hruby, V.; Kessler, R.; McClaine, A.; Petty, S.; Solbes, A. (Avco Everett Research Lab., Inc., MA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Recent results in MHD generator development work are described. The problem of electrode lifetime in a slagging environment is studied, and the results of two duration tests conducted in the Mark VI facility are described. A 250 hour test is described in detail. The transonic and subsonic behavior of high interaction MHD channels is studied. Theoretical and experimental results are presented which shed some light on some of the important characteristics of the behavior of subsonic channels when operated off design.

38976 (CONF-781009—, pp 347-380) **Studies of diagonal MHD channels at the U-25 facility during duration operation.** Buznikov, A.E.; Zhelnin, V.A.; Karpukhin, A.V. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Results of studies of the diagonal channels R, RM, and 1V at the U-25 facility are presented and discussed. Channel designs, channel structure tests, and loading and electrical characteristics of the channels are studied. (WHK)

38977 (CONF-781009—, pp 543-570) **Studies of MHD generator loading.** Antonov, B.M.; Bitiurin, V.A.; Buznikov, A.E.; Kovbasiuk, V.I.; Liubimov, G.A.; Momotov, Yu.M. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The objective of optimal loading of an MHD channel is to extract from the channel the power generated in each plasma volume element with minimal losses. Loading principles are reviewed, and Faraday loading and diagonal loading are discussed in detail. Also, special features of inverter operation as loading elements are considered. (WHK)

38978 (CONF-781009—, pp 635-687) **Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries.** Gokhstein, Ya.P.; Romanov, A.I.; Sokolov, Yu.N.; Liubimov, V.D. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The electrochemical processes occuring in the solid electrolyte ZrO_2—CaO and ZrO_2—Y_2O_3 on the boundary with platinum current leadout were studied for use in high-temperature MHD channels. It was established that in the process of electrolysis the mechanism of the new phase formation in the cathode area of ZrO_2—Y_2O_3 differs from the mechanism of the new phase formation in ZrO_2—CaO. It was experimentally demonstrated that while an electrochemical barrier layer forms on the interface of the platinum anode and the ceramic ZrO_2—CaO, no such barrier forms in the ceramic ZrO_2—Y_2O_3. As a result of electrochemical studies of the ZrO_2—CaO and ZrO_2—Y_2O_3 ceramic with current leadout of ZrO_2—In_2O_3, it was established that the ceramic current leadout with an In_2O_3 base eliminates the chemical processes resulting in the destabilization and destruction of solid electrolytes, on both the cathode and the anode area of the composition. The presence of the ceramic current leadout blocks the anion conductivity in solid electrolytes and the degree of this blockage increases as the electrical field strength grows. The ceramic current leadout based on In_2O_3 makes it possible to use successfully solid electrolyte electrodes with anionic conductivity. As a result of electrochemical study of interphase boundaries in solid electrolytes with ZrO_2 base and current leadout compositions with In_2O_3 base, the ceramic rammed mass, and the combined ceramic-rammed mass electrodes have been developed and studied in the open cycle MHD generator channel. These electrodes passed successful tests in the MHD channels of the U-02, U-25 and U-25B facilities.

38979 (CONF-781009—, pp 749-772) **Diagnostics of combustion products plasma based on its fluctuation characteristics.** Bystry, A.I.; Ganefel'd, R.V.; Yemets, Yu.P.; Mazur, N.I.; Red'kin, V.B.; Shidlovskiy, A.K. (Inst. of Electrodynamics, Kiev, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Investigations of fluctuation processes in MHD generators provide new possibilities for the diagnostics of plasma parameters and of physical phenomena in plasma. The level of fluctuations and their spectral characteristics can be used to indicate the operation efficiency of the combustor and energy conversion in the MHD channel and to establish the presence of interelectrode breakdowns. It is shown how fluctuation characteristics can be utilized to determine the load factor of the MHD generator and the electrical conductivity of plasma, critical current density for the transition of the diffuse discharge into a constricted discharge and the characteristic time of this process.

38980 (CONF-781009—, pp 775-800) **Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry.** Kuzmenko, P.; Reigel, F.O.; Self, S.A. (Stanford Univ., CA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The utility of submillimeter wave propagation as a nonintrusive diagnostic technique for accurate measurements of electron concentration, n/sub e/, and mobility, μ/sub e/, in combustion MHD flows has been established by preliminary measurements. A laser operating at 496 μm, optically pumped by a CO_2 laser, was used with a Michelson interferometer to measure n/sub e/ from the fringe shift observed with the addition of potassium seed to the flow. The mobility was obtained from the measured absorption of the submillimeter radiation. In this preliminary work, measurements were made on the free jet issuing from the nozzle ($\sim$ 10 x 5 cm) of the M-8 combustor burning ethanol at a thermal power of $\sim$ 1 MW and a temperature of $\sim$ 2700 K. The measured n/sub e/ agreed very well with equilibrium calculations based on the temperature obtained both by independent spectroscopic measurements and also from a careful heat balance. The mobility agreed well with computation based on the accepted best estimates of collision cross sections. Further experiments are currently being mounted to make in-channel measurements through suitable access ports, and to establish the use of the technique in ash-laden, coal-fired flows. Since at submillimeter wavelengths, the Rayleigh scattering from ash droplets is negligible, the technique should be applicable to coal-fired flows of large dimensions. The current status and results of these experiments are reported. In addition, the extension of the technique to large scale MHD flows is discussed.

38981 (CONF-781009—, pp 801-823) **Development of working fluid diagnostics for large MHD generators by means of submillimeter lasers.** Vasil'eva, I.A.; Tolchinskii, L.S.; Urinson, A.S.; Yundev, D.N. (Inst. of High Temperatures, Moscow, USSR). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The use of submillimeter lasers for diagnostics of the working fluid of open cycle MHD generators appears to be promising. Experiments conducted indicate the possibility of utilizing the gas discharge HCN laser at the wavelength $\lambda = 0.337$ mm for plasma diagnostics in large MHD generators. However, the working fluid parameters reached at the present time in such installations limit the use of radiation to the wavelength $\lambda = 0.337$ mm. This limitation is imposed by attenuation due to electrons. For channel width $>$ or $\sim$ = 1 m, it is necessary to decrease the wavelength of the probing beam approximately two times (in this case attenuation decreases 4 times), maintaining the possibility of an accurate selection of the wavelength by means of laser adjustment in order to avoid radiation absorption by other than the electron plasma component.

38982 (CONF-781009—, pp 849-883) **Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas.** Wormhoudt, J.C.; Kolb, C.E. (Aerodyne Research Inc., Bedford, MA). 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

The two potential ash vapor-induced effects on MHD coal plasma conductivity are briefly reviewed. This review is followed by a description of the molecular beam mass spectrometer sampling system and laboratory scale coal plasma combustor which have yielded the first direct measurement of many of the deleterious ash vapor species predicted by computer codes. After analysis of preliminary laboratory results on the positive and negative ion species found in laboratory produced, atmospheric pressure, coal combustion plasmas, a discussion of the feasibility of using molecular beam, mass spectrometric sampling techniques to characterize the plasmas produced in full-scale, coal-fired MHD combustors and generators is presented.

38983 (PB—286074) **Performance characteristics of automotive engines in the United States. First series - Report No. 14. 1975 Mazda rotary 70 CID (1.1 liters), 4v. Interim report, July 1977.** Marshall, W.F.; Stamper, K.R. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). May 1978. 40p. NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Mazda 70 CID, 4V rotary engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

38984 **Plasma luminosity fluctuations as a diagnostic tool.** Scott, M.H.; Dicks, J.B. (Univ. of Tennessee Space Inst., Tullahoma). pp V.2.6-V.2.11 of Engineering aspects of magnetohydrodynamics. Bienstock, D. (ed.). University, MS; University of Mississippi (1977).

From 16. engineering aspects of MHD symposium; Pittsburgh, PA, USA (16 May 1977).

The diagnostic utility of the radiation emitted by a combustion plasma is discussed and illustrated in terms of results obtained at the direct coal-fired MHD Facility at the University of Tennessee. The measurement of this parameter allows the determination of relative temperature profiles as well as average propagation velocity. Furthermore, two new concepts concerning the utility of this measurement are introduced. First, the fluctuations of the measured parameter, when examined in terms of frequency content provide a measure of the relative quality of the combustion plasma as related to the presence of non-uniformities that are detrimental to the MHD generator. Secondly, the cross-correlation between two axially separated measurements provides provides a measure of the velocity fluctuations present in the flow.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 38302

THERMIONIC CONVERTERS

PERFORMANCE AND TESTING

38985 (N—78-27174) **Performance of a thermionic converter module utilizing emitter and collector heat pipes.** Kroeger, E.; Morris, J.; Miskolczy, G.; Lieb, D.P.; Goodale, D.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1978. Contract NAS3-20270. 38p. NTIS PC A03/MF A01.

A thermionic converter module simulating a configuration for an out-of-core thermionic nuclear reactor was designed, fabricated, and tested. The module consists of three cylindrical thermionic converters. The tungsten emitter of the converter is heated by a tungsten, lithium heat pipe. The emitter heat pipes are immersed in a furnace, insulated by MULTI-FOIL thermal insulation, and heated by tungsten radiation filaments. The performance of each thermionic converter was characterized before assembly into the module. Dynamic voltage, current curves were taken using a 60 Hz sweep and computerized data acquisition over a range of emitter, collector, and cesium-reservoir temperatures. An output power of 215 W was observed at an emitter temperature of 1750 K and a collector temperature of 855 K for a two diode module. With a three diode module, an output power of 270 W was observed at an average emitter temperature of 1800 K and a collector temperature of 875 K.

FUEL CELLS

DESIGN AND DEVELOPMENT

38986 **Overchargeable sealed metal oxide/lanthanum nickel hydride battery.** van Ommering, G.; Dunlop, J.D. (to Communication Satellite Corp.). US Patent 4,107,395. 15 Aug 1978. Filed date 20 Sep 1977. 8p.

This invention relates to improvements in the construction of metal oxide/lanthanum nickel hydride storage batteries. A stack construction is disclosed which allows recombination of oxygen before it reaches the hydride electrode. The oxygen gas is forced to escape from the back of the metal oxide electrode where it is reduced at a catalyst electrode held at the potential of the lanthanum nickel electrode. With rapid recombination, no build-up of pressure occurs and no oxygen gas will arrive at the hydride electrode which would tend to damage it. In one embodiment, the hydride electrode is separated from the metal oxide electrode by a fuel cell-type separator. In one embodiment, a single oxygen reduction electrode is placed between two back-to-back metal oxide electrodes, and the reduction electrode is connected to the two common leads to the hydride electrodes. In a second embodiment, the reduction electrodes are pressed against or attached to the hydride electrodes.

PERFORMANCE AND TESTING

38987 (AD-A—058380) **Evaluation and optimization of solid polymer electrolyte (SPE) fuel cells. Final technical report, 23 May 1977-23 April 1978.** MacLeod, E.N.; McElroy, J.F. (General Electric Co., Wilmington, MA (USA)). 15 May 1978. Contract DAAK70-77-C-0128. 45p. NTIS PC A03/MF A01.

The reaction air of a fuel/air solid polymer electrolyte (SPE) fuel cell was water saturated utilizing excess moisture in the fuel by diffusion thru an uncatalized portion of the SPE. This device eliminated the need for external humidification controls. Fuel/air current densities up to 750 ma/sq cm were demonstrated. (Author)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 39230

38988 (AD-A—058456) **Improved anodes for liquid hydrocarbon fuel cell. Research and development technical report.** Perry, J. (Army Electronics Research and Development Command, Fort Monmouth, NJ (USA). Electronics Technology/Devices Lab.). Apr 1978. 17p. NTIS PC A02/MF A01.

Low power fuel cells operating on liquid hydrocarbons, such as methanol and ethylene glycol, have received renewed attention. The current state-of-the-art of anodes used in liquid hydrocarbon fuel cells operating at ambient temperatures of 22 C consist of platinum and palladium catalyst loadings of approximately 10 mg/sq cm. The cost and quantity of these noble metals required for anode electrode fabrication are high. Investigations conducted to reduce the noble metal catalyst loadings have lead to the development of an electrode consisting of graphite, platinum (2.4 mg/sq cm), and anodic lead dioxide. Cells fabricated with the new anode (graphite, platinum, and lead dioxide) and silver amalgam cathodes were capable of operating at current densities of 20 mA/sq cm at 0.60 V when charged with an anolyte solution of either methanol in potassium hydroxide or ethylene glycol in potassium hydroxide. (Author)

38989 (LBL—8975, pp 70.-72.) **Catalytic activity of transition-metal carbides.** Williams, W.S. (Univ. of Illinois, Urbana). Feb 1979. In Heterogeneous catalysis research meeting.

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 39247, 39248

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

BUILDINGS

REFER ALSO TO CITATION(S) 38470, 38478, 38907

38990 (AD-A—058637) **Improved engine performance through heat transfer control. Final report, 1 June 1976—30 June 1978.** Murray, R.G. (Oklahoma State Univ., Stillwater (USA). Coll. of Engineering). 28 Jul 1978. 111p. NTIS PC A06/MF A01.

The advance of technology requires engines to be more efficient, weigh less, and be more reliable. Common materials used for engine parts are not designed close to their thermal limit for strength and lubrication. Additional component loading necessarily will demand a corresponding increase in component cooling. This increased cooling not only represents a thermodynamic loss that detracts from cycle efficiency but it also consumes additional engine power to operate the cooling system. A new approach to the thermal loading problem is to apply a thin layer of a ceramic insulator to combustion chamber surfaces thereby reducing heat transfer and metallic component temperature. The following document describes the results of a test program to evaluate engine performance for engines having ceramic coatings. Both spark and compression ignition performance was examined. (Author)

38991 (AD-A—059309) **Development of an Air Force Facilities Energy Information System. Master's thesis.** Manchester, D.F.; Schuldt, R.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Jun 1978. 156p. NTIS PC A08/MF A01.

There is some doubt about whether or not Air Force Civil Engineering personnel, who are responsible for the planning, construction, operation, and maintenance of all Air Force facilities, have the proper background information to cope with the current energy crisis. This thesis analyzes the results of a survey of over 500 Civil Engineering officers and equivalent civilians on the subject of energy information. The analysis shows that, in spite of the recent interest in energy, very few managers feel that they have enough background information to make educated decisions about energy problems in their functional areas. Seventy-seven percent of the respondents feel that Civil Engineering needs an energy background information system. Based on questionnaire responses, readings, and interviews, the requirements for such a system are discussed. Sources of energy information which should be incorporated into an Air Force Energy Information System are described. The system could be established during the current headquarters reorganization.

38992 (CONF-790446—4) **Heat pump modeling: a progress report.** Ellison, R.D.; Creswick, F.A.; Rice, C.K.; Jackson, W.L.; Fischer, S.K. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

From 4. annual heat pump technology conference; Stillwater, OK, USA (9 Apr 1979).

Computer models of the performance of heat pumps and of individual components are described; preliminary results from system improvement studies using these models are presented. The system model which is based on the underlying physical principles, rather than empirical data, uses a calculational scheme used previously by Hiller and Glicksman. It is generalized so that it may be used to calculate performance and efficiency over a broad range of operating conditions. Its intended use is the investigation of changes in system performance brought about by modifications of the individual components, and to aid in gaining detailed understanding of the interactions between components. Examples of predicted improvements in performance based on the use of these programs are presented. New heat exchanger models, based on a tube-by-tube computational approach, may be used by the system model when appropriate. In these models, the thermal and fluid flow performance of each tube in the heat exchanger is computed individually using

local temperatures and heat transfer coefficients. Tube circuiting sequences may be specified by the user, the joining or branching of parallel refrigerant circuits is accommodated, and appropriate mixing expressions are used. Air-side correlations for any surface geometry may be specified. Comparison of calculated and observed performance parameters for heat exchangers in the laboratory are shown.

38993 (HIT—689) **National energy plan: energy conservation with insulation. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). 6 Jul 1977. Contract EY-76-C-03-1226. 21p. Dep. NTIS, PC A02/MF A01.

The energy savings potential of the building insulation-related elements of the National Energy Plan mandates prescribing levels of insulation (particularly in new buildings) and financial incentives for encouraging the insulation of buildings are discussed. The energy savings are estimated to be 1.2 QBtu/yr in 1980, 1.7 QBtu/yr in 1985, 1.9 QBtu/yr in 1990, and 2.8 QBtu/yr in 2000 A.D. (LCL)

38994 **Wood burning stove with forced air heating.** Glover, T.L. US Patent 4,140,101. 20 Feb 1979. Filed date 6 Jul 1977. 6p.

The invention discloses a stove having an external casing provided with an opening and a cylindrical fire chamber disposed within the casing and provided with a hole arranged adjacent to and in communication with the opening of the casing. Extending transversely across the cylindrical fire chamber is a grate, while a door assembly is disposed removably covering the opening provided in the external casing. Included in the door assembly is a hinged cover provided with a vent for controlling draft in the fire chamber, and with a lock which releasably secures the cover to a cowl of the door assembly on which the cover is hingedly mounted.

38995 (LBL—8892) **Indoor air quality in energy-efficient buildings.** Hollowell, C.G.; Berk, J.V.; Lin, C.I.; Turiel, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 14p. (CONF-790523—2). Dep. NTIS, PC A02/MF A01.

From 2. international CIB symposium on energy conservation in the built environment; Copenhagen, Denmark (27 May 1979).

The relationship between ventilation rate and indoor air quality is being investigated with a mobile laboratory designed specifically for studies of indoor air quality and energy utilization in buildings before and after energy conservation retrofits, and in new buildings incorporating energy-efficient designs. The characterization program includes measurement of infiltration rate (continuous C_2H_6 and N_2O tracer gas method), CO, CO_2, NO, NO_2, SO_2, O_3, formaldehyde, total aldehydes, radon and particulate mass and chemical composition. Results of the initial phases of this program indicate that the concentrations of some air pollutants in the built environment are higher than outdoor levels and in some cases even exceed recommended health and comfort criteria when infiltration and ventilation rates are reduced.

38996 (N—78-31541) **JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings.** Lansing, F.L.; Chai, V.W.; Lascu, D.; Urbenajo, R.; Wong, P. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1978. Contract NAS7-100. 239p. NTIS PC A11/MF A01.

The engineering manual provides a complete companion documentation about the structure of the main program and subroutines, the preparation of input data, the interpretation of output results, access and use of the program, and the detailed description of all the analytic, logical expressions and flow charts used in computations and program structure. A numerical example is provided and solved completely to show the sequence of computations followed. The program is carefully structured to reduce both user's time and costs without sacrificing accuracy. The user would expect a cost of CPU time of approximately $5.00 per building zone excluding printing costs. The accuracy, on the other hand, measured by deviation of simulated consumption from watt-hour meter readings, was found by many simulation tests not to exceed + or - 10 percent margin.

38997 **Building heating system.** McKillop, D.C. Sr. US Patent 4,142,679. 6 Mar 1979. Filed date 29 Jun 1977. 4p.

A heat jacket and flue assembly includes an air inlet in the attic for communication with humid outside air and an outlet adjacent the furnace in communication with the area to be heated. A fan moves air from the outside through the attic into the heat jacket and flue assembly where it is heated by the smoke being exhausted through the flue pipe and then it is distributed to the area to be heated directly or through the furnace.

38998 **Heating appliances.** Morris, W.H.D.; Couchman, W.J.R. US Patent 4,142,506. 6 Mar 1979. Priority date 18 Aug 1976, Ireland, 4p.

The invention provides a heating appliance which comprises a combustion chamber, a boiler adjacent the combustion chamber, and a flue system for conveying combustion gases from the combustion chamber. The flue system has two different routes for conveying combustion gases and a damper which may be selectively positioned to cause the gases to pass predominantly along either one or the other route. This arrangement permits the heat output to the boiler and an associated cooker unit to be varied while a constant firing rate is maintained in the combustion chamber. The appliance is preferably operated on solid fuel.

38999 **Waste energy recovery system.** Kuklinski, H.W. US Patent 4,142,379. 6 Mar 1979. Filed date 16 Aug 1976. 4p.

The invention discloses an energy saving device that utilizes the rejected heat from an air conditioning unit for heating water or other suitable liquid in a conventional liquid heating storage tank. The primary heater control in the storage tank is turned off whenever the air conditioning compressor is operating by a pressure sensing switch in the compressor line that is wired in series with the tank heater control circuit. A water circulating pump is used to pass relatively cold tank water through a heat exchanger which is connected to the compressor outlet conduit of the air conditioner. The pump is controlled by a thermostatic switch which measures heat exchanger outlet water temperature. The device not only utilizes otherwise rejected heat energy from an air conditioning unit for heating water in a conventional hot water tank but also increases the efficiency and endurance of the air conditioning system by removing super heat from the compressor gases.

39000 **Combined heat pump system and ice making system.** Bottum, E.W. US Patent 4,142,678. 6 Mar 1979. Filed date 11 Jul 1977. 4p.

A combined heat pump system and ice making system is described that includes a heat pump system used for normal heating purposes. The heat pump system is augmented with an ice making system wherein ice is formed on the system evaporator. This ice making improves the operational efficiency of the heat pump system during cold or sunless periods. Additionally, the resulting ice is collected and stored for use as ice.

39001 **Run-around type energy recovery system.** Glancy, W.P. US Patent 4,142,575. 6 Mar 1979. Filed date 12 Nov 1975. 14p.

The invention discloses a method and apparatus to recover energy from used or foul air and to return the energy into fresh air to reduce the energy input to aventilation system. Ventilation apparatus is adapted to maintain fluid flow through a first heat exchanger, positioned in a fresh air passage, and through a second heat exchanger, positioned in an exhaust passage, at a controlled rate to afford maximum or controlled heat transfer efficiency for pre-cooling or pre-heating fresh air drawn into the system. Control apparatus is provided to maintain flow of fluid through the heat exchangers such that the sum of the mass flow of fresh air times the specific heat of the fresh air, plus the mass flow of the exhaust air times the apparent specific heat of exhaust air, is equal to two times the mass flow of fluid times the specific heat of the fluid.

39002 **Heat pump system with improved heat transfer.** Perry, E.R.; Rabinowitz, M. (to Electric Power Research Inst., Inc.). US Patent 4,142,576. 6 Mar 1979. Filed date 26 May 1977. 10p.

A heat pump is described for cooling or heating a conditioned space includes an underground heat pipe laid into a hole in the ground back-filled with soil. The heat transfer of the soil is improved by dispersing highly water-absorbent hydrophilic polymeric gel particles soaked with water around the heat pipe. The water-soaked particles preferably are coated with a water-impermeable film. The water may also be entrapped in liquid form in small bags. Also, a water impermeable sheath may be formed around the back-fill soil to minimize evaporation from the particles.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 38902, 38930, 38940

39003 (CONF-7809138—1) **Residential electric heating and cooling: total cost of service.** Asbury, J.G.; Giese, R.F.; Mueller, R.O. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 21p. Dep. NTIS, PC A02/MF A01.

From 6. annual Illinois energy conference on electric utilities; Chicago, IL, USA (27 Sep 1978).

Several technologies under consideration for US heating and cooling applications are already available from European manufacturers. These include storage resistance-heating systems and bivalent (dual-fuel) resistance-heat and heat-pump systems. In addition, electric utilities are testing and evaluating storage air conditioners and solar/resistance and solar-assisted heat-pump systems. A number of these newer technologies offer substantially improved energy efficiency. However, aside from meeting requirements of reliability, maintainability, and consumer comfort, their potential for gaining acceptance among utility planners ultimately will depend upon their overall economic competitiveness relative to conventional systems. Findings of a recent study at Argonne National Lab. to evaluate and

compare total costs of supplying space heating and cooling services with these alternative technologies are reported here. Both the utility's cost of service and those device investment and maintenance costs borne directly by the customer were evaluated. Unlike the usual assumption of constant (time-dependent) electric supply costs, the study used a detailed cost allocation model to calculate the utility capital and operating costs to meet device-specific loads.

39004 (HIT—691) **National energy plan: energy conservation in appliances. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). 6 Jul 1977. Contract EY-76-C-03-1226. 16p. Dep. NTIS, PC A02/MF A01.

The energy savings to the U.S. that could result from compliance with minimum efficiency standards for household appliances, as set forth in the National Energy Plan, selected current appliance technologies, and federal programs related to appliance energy conservation are discussed. The energy savings potential of implementing the proposed household appliance standard are estimated as 0.1 QBtu/yr in 1980, 0.2 QBtu/yr in 1985 and 1990 and 0.3 QBtu/yr in 2000 A.D. (LCL)

39005 (PB—283722) **Air leakage measurements in three apartment houses in the Chicago area.** Hunt, C.M.; Porterfield, J.; Ondris, P. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jun 1978. 28p. NTIS PC A03/MF A01.

Air infiltration measurements were made in three apartment houses in the Chicago area using SF6 as a tracer gas. Two were in tenement districts and one was suburban. Data were collected in selected apartments in each building, and these data were used to estimate the infiltration rate for the entire building. Whole building estimates of 0.94 and 1.2 air changes per hour were obtained under the conditions of tests in the tenement apartments, and 0.82 air changes per hour in the suburban apartment. Comparisons of the tightness of individual dwelling units by fan pressurization-depressurization techiques were also made. The suburban apartment was found to be much tighter than the other two apartments. The difference was much greater than predicted by the tracer tests. An analysis of the ASHRAE Crack Method is also made. (Portions of this document are not fully legible)

39006 **Fireplace systems.** Stanko, J.J. US Patent 4,142,507. 6 Mar 1979. Filed date 5 Jul 1977. 4p.

A fireplace heating system is provided having a fireplace box having a fireplace opening therein, a heat chamber surrounding the box, a plurality of spaced generally vertically extending flues connected to the fireplace box and holding the box suspended generally centrally of the heat chamber, the flues being adapted to carry the exhaust gases from the fireplace box, a hot air distribution duct connected to the heat chamber and surrounding the flues over a portion of their length, the distribution duct having discharge vent means into the room being heated, a pre-heat chamber spaced from the heat chamber and the hot air distribution duct and surrounding the flues over a second portion of their length, a cold air inlet connected to the pre-heat chamber, a blower connected to the pre-heat chamber on the side of the pre-heat chamber opposite the cold air inlet receiving preheated air passing around the second portion of the flues from the pre-heat chamber for delivery to the heat chamber and chimney means connected to the flues receiving exhaust gases therefrom.

39007 **Feasibility of heat pumps for residential space heating in New Zealand.** Shaw, R.A.; Stephenson, J. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1977). 45p. (NZERDC—18).

A systems study of the viability of air—air heat pumps for space heating of New Zealand houses is presented. Although suitable, heating-only heat pumps are not yet available on the market, their arrival is imminent and does not depend on new technology. A specification for a New Zealand heating-only heat pump has been prepared. The effects of thermal comfort standards, climate, and housing construction on heating requirements are discussed. Provision of these heating requirements with heat pumps is suggested. The highly important aspects of heat pump energy consumption and economics are discussed. Twelve case studies are defined, ranging from a fully insulated partially heated house in Auckland (lowest heating energy requirement) to an uninsulated, fully heated house in Invercargill (highest heating energy requirement). For these case studies, a comparison was made between an air—air heat pump system and a conventional high quality electrical resistance heating system. A breakeven electrical energy cost at which heat pumps are competitive with electrical resistance heating was determined. The breakeven costs range from 8.10 cents/kWh for the Auckland case above, to 0.55 cents/kWh for the other extreme case in Invercargill. In summary, the heat pump alternative is feasible for 9 out of the 12 cases analyzed at present electrical energy consumer tariffs. Total energy conservation potential for New Zealand is discussed, including a scenario look at total conservation potential for the year 1986. It is shown that the potential for electrical energy conservation amounts to that generated during the winter by a large (1020 MW) central power station.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 38899, 38900, 38901

39008 (DOE/TIC—10064) **Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities.** (Unified Industries, Inc., Alexandria, VA (USA)). 31 Oct 1978. Contract EM-77-C-01-8962. 51p. Dep. NTIS, PC A04/MF A01.

All program activities that DOE should perform as part of its management responsibilities for carrying out the President's directive for conserving energy in Federal buildings and operations are identified and analyzed. Activities in which DOE should not become involved are also identified. The basic authorities include: the Energy Policy and Conservation Act 381 (1975), Executive Order 11912 (1976), Public Law 95-91 (1977), Executive Order 12003 (1977), and the proposed National Energy Act. Other authorities and commitments are contained in tasking agency memoranda, interagency agreements, working group minutes, White House memoranda, and GAO audits. A summary of the authorities applicable to the Federal Energy Management Program (FEMP) are given. Based on the analyses, twelve recommendations are presented as strategies for DOE to carry out the initiatives.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 38899, 38900, 38901, 39008

39009 (HIT—687) **Assessment of energy conservation measures applied to oil heated buildings. (Task 700).** (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1977. Contract EY-76-C-01-2113. 32p. Dep. NTIS, PC A03/MF A01.

The energy conservation potential of retrofit measures for conserving heating oil in hospitals, schools, public housing and public buildings are assessed; the cost effectives of retrofit measures are compared; and payback periods for such retrofitting are estimated. The retrofit measures include means for improving thermal insulation; preventing heat losses; use of set-back thermostats; and improved efficiency of space and water heating equipment. Tabulated data for the calculated energy savings in each type of building in various geographic areas are presented. (LCL)

39010 (LBL—8893) **Automatic variable ventilation control systems based on air quality detection.** Turiel, I.; Hollowell, C.D.; Thurston, B.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 12p. (CONF-790523—1). Dep. NTIS, PC A02/MF A01.

From 2. international CIB symposium on energy conservation in the built environment; Copenhagen, Denmark (27 May 1979).

Mechanical ventilation systems usually provide a fixed quantity of fresh air to a building space based upon the maximum number of people expected to occupy that particular space. When the use of a building space is below its design maximum, the amount of outside air brought into that space can be reduced, thus generally also reducing energy consumption through lower heating and cooling loads. One method of determining the necessary ventilation rate for a particular space is to utilize an air quality detector (e.g., CO_2 or O_2) sensitive to building occupancy and activity load. The output of this detector can in turn be used to control ventilation rates.

39011 (PB—284067) **An energy conservation retrofit process for existing public and institutional facilities.** (Public Technology, Inc., Washington, DC (USA)). 1977. Contract NSF-C834. 110p. NTIS PC A06/MF A01.

This manual was developed to provide assistance to public officials considering energy conservation in existing public buildings. It focuses on management decisions which must be made in implementing energy conservation programs for existing buildings; and provides assistance in developing a plan of attack, establishing schedules, selecting buildings, creating preliminary energy savings estimates, developing engineering work statements, evaluating consultants, estimating fees, and rough estimating of construction costs.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 38906, 39010

39012 (CONS—8630-T1) **Buildings energy management program workshop design. Final report.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Dec 1978. Contract EM-76-C-01-8630. 66p. Dep. NTIS, PC A04/MF A01.

This document describes activities undertaken by Honeywell's Energy Resources Center for design and development

of the format, content, and materials that were used in conducting 129 one-day energy management workshops for specific commercial business audiences. The Building Energy Management Workshop Program was part of a National Workshop Program that was intended to increase awareness of energy-related issues and to encourage energy-conservation actions on the part of commercial and industrial sectors. The total effort included executive conferences for chief executive officers and other senior management personnel; industrial energy-conservation workshops directed at plant management and engineering personnel; vanpooling workshops designed to inform and encourage business in implementing a vanpooling program for employees; and the building energy-management workshops specifically developed for managers, owners, and operators of office and retail facilities, restaurants, and supermarkets. The total program spanned nearly two years and reached approximately 2,500 participants from all parts of the U.S. A detailed followup evaluation is still being conducted to determine the impact of this program in terms of conservation action undertaken by workshop participants.

39013 (HIT—690) **National energy plan: energy conservation with heat pumps. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). 6 Jul 1977. Contract EY-76-C-03-1226. 21p. Dep. NTIS, PC A02/MF A01.

The energy savings potential of heat pump-related elements of the National Energy Plan, heat pump technologies which may be affected by the plan, and current federal programs directed at developing and implementing energy-conserving heat pumps are discussed. The potential savings with heat pumps in commercial buildings are estimated to be 0.1 QBtu/yr in 1980 and 1985, 0.2 QBtu/yr in 1990, and 0.3 QBtu/yr in 2000 A.D. (LCL)

39014 (HIT—692) **National energy plan: energy conservation in lighting. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). 6 Jul 1977. Contract EY-76-C-03-1226. 18p. Dep. NTIS, PC A02/MF A01.

Estimates are made of the energy savings in the lighting of commercial buildings that could be achieved through implementation of the President's National Energy Program. Existing lighting technology and federal programs aimed at developing energy-conserving lighting technologies are discussed. The energy savings in lighting commercial buildings are estimated to be 0.02 QBtu/yr through the year 2000. (LCL)

39015 **Energy monitor and control system.** Borkan, W.N. US Patent 4,146,923. 27 Mar 1979. Filed date 26 Apr 1977. 16p.

A system for controlling a plurality of variable rate energy consuming units is described. The system uses a unique sequence to optimize the number of units on and the total consumption of the units relative to a target by increasing and decreasing total consumption from a status position in the sequence in response to a comparison of the total consumption of all units with a target and to a comparision of the total consumption with the target minus the differential consumption to the next step from the status position in the unique sequence. The units status and the results of the comparisons address a device for storing the unique sequence to provide consumption requested status which may be overridden by a cycling means to provide a minimum and maximum off time and minimum on time demand command status for demand controllable units. A real time clock addresses a storage device to provide command status for time controllable units. The time command status and demand command status may be ORed to provide command status for units which are both demand and time controllable.

TRANSPORTATION

REFER ALSO TO CITATION(S) 38859, 38941

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 39137, 39139, 39140, 39179

39016 (N—78-31043) **Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing.** Perry, B.I. (National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Sep 1978. 26p. NTIS PC A03/MF A01.

The hinge moments, at selected flight conditions, resulting from deflecting two trailing edge control surfaces (one inboard and one midspan) on a high aspect ratio, swept, fuel conservative wing with a supercritical airfoil are estimated. Hinge moment results obtained from procedures which employ a recently developed transonic analysis are given. In this procedure a three dimensional inviscid transonic aerodynamics computer program is combined with a two dimensional turbulent boundary layer program in order to obtain an interacted solution. These results indicate that trends of the estimated hinge moment as a function of deflection angle are similar to those from experimental hinge moment measurements made on wind tunnel models with swept supercritical wings tested at similar values of free stream Mach number and angle of attack.

39017 (N—78-31085) **Study of fuel systems for LH2-fueled subsonic transport aircraft. Volume 1. Final report, September 1976—December 1977.** Brewer, G.D.; Morris, R.E.; Davis, G.W.; Versaw, E.F.; Cunnington, G.R. Jr. (Lockheed-California Co., Burbank (USA)). Jul 1978. Contract NAS1-14614. 202p. NTIS PC A10/MF A01.

Several engine concepts examined to determine a preferred design which most effectively exploits the characteristics of hydrogen fuel in aircraft tanks received major emphasis. Many candidate designs of tank structure and cryogenic insulation systems were evaluated. Designs of all major elements of the aircraft fuel system including pumps, lines, valves, regulators, and heat exchangers received attention. Selected designs of boost pumps to be mounted in the LH2 tanks, and of a high pressure pump to be mounted on the engine were defined. A final design of LH2-fueled transport aircraft was established which incorporates a preferred design of fuel system. That aircraft was then compared with a conventionally fueled counterpart designed to equivalent technology standards.

39018 (N—78-31086) **Study of fuel systems for LH2-fueled subsonic transport aircraftVolume 2. Final report, September 1976—December 1977.** Brewer, G.D.; Morris, R.E.; Davis, G.W.; Versaw, E.F.; Cunnington, G.R. Jr. (Lockheed-California Co., Burbank (USA)). Jul 1978. Contract NAS1-14614. 356p. NTIS PC A16/MF A01.

For abstract, see N78-31085.

39019 **1977 international air transportation conference.** New York, NY; American Society of Civil Engineers (1977). 415p. (CONF-7704104—). $16.00.

From International air transportation conference; Washington, DC, USA (4 Apr 1977).

Twenty-one papers were presented at the meeting. A separate abstract was prepared for each of 2 papers. The remaining 19 papers were not in scope for the data base. (LCL)

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 38938, 39053

39020 (COO—4338-4) **Air leakage in refrigerated vans. Final report.** (Bodenheimer (B.A.) and Co., Inc., Stamford, CT (USA)). Dec 1978. Contract EC-77-C-02-4338. 108p. Dep. NTIS, PC A06/MF A01.

The Air Leakage in Refrigerated Vans Project was initiated by the Department of Energy to assess the impact of air leakage on fuel consumption of highway transport refrigeration equipment. The project, conducted from September of 1977 to December of 1978 collected air leakage data on refrigerated trailers, containers and truck bodies. A Prototype Air Leakage Test Set was developed, designed and constructed to take measurements, and a total of 92 representative vehicles were examined. The results of the study indicate that air leakage causes a 25% increase in the average refrigeration load. However, the majority of transport refrigeration units are equipped with control systems that require the power to be supplied continuously, so that the potential reduction in fuel consumption that can be expected by reduced air leakage is limited. Alternative control techniques and power sources for the control and operation of refrigeration unit components other than the compressor could reduce fuel consumption by approximately 60%.

39021 (N—78-28993) **Phase 1: definition of intercity transportation comparison framework. Volume 1: summary. Final report.** (Operations Research, Inc., Silver Spring, MD (USA)). 19 Jul 1978. Contract NAS2-9815. 42p. NTIS PC A03/MF A01.

A unified framework for comparing intercity passenger and freight transportation systems is presented. Composite measures for cost, service/demand, energy, and environmental impact were determined. A set of 14 basic measures were articulated to form the foundation for computing the composite measures. A parameter dependency diagram, constructed to explicitly interrelate the composite and basic measures is discussed. Ground rules and methodology for developing the values of the basic measures are provided and the use of the framework with existing cost and service data is illustrated for various freight systems.

39022 (N—78-28994) **Phase 1: definition of intercity transportation comparison framework. Volume 2: methodology. Final report.** (Operations Research, Inc., Silver Spring, MD (USA)). 19 Jul 1978. Contract NAS2-9815. 251p. NTIS PC A12/MF A01.

Categories of cost and service measures that will appropriately define the characteristics of all intercity transportation systems were established. Previous methods of comparing transportation systems were reviewed. Specific comparison variables, applicable to all modes were defined, and the functional relationships by which

these variables are interdependent were explored. A framework by which the set of variables may be employed for comparison of data from the individual systems was constructed.

39023 (PB—283931) **Analysis of production cars' fuel economy.** Janz, R.F. (Aerospace Corp., El Segundo, CA (USA)). Oct 1976. Contract EPA-68-01-0417. 37p. NTIS PC A03/MF A01.

Harmonic mean fuel economies, in miles per gallon, were computed for nine carline classes which were common to the California Title 13 Data Base and the U.S. Environmental Protection Agency (EPA) Certification Test Data Base for 1975 and 1976 model years. The parameters used to define a carline class were: model year, inertia weight, cubic inch displacement, number of carburetor barrels, and transmission type.

39024 (PB—283946) **Analysis of GM fuel economy surveys. Final report.** Janz, R.F. (Aerospace Corp., El Segundo, CA (USA)). Oct 1976. Contract EPA-68-01-0417. 302p. NTIS PC A14/MF A01.

Data obtained by General Motors Corporation in three fuel economy surveys of 1975 GM private passenger car owners are analyzed to determine seasonal, topographical, and geographical effects on the fuel economy of in-use vehicles. Data from the GM survey for 1532 cars formed the basis for this study. Additional seasonal, topographical, and geographical data associated with the locations of the owners were acquired from the literature and added to the GM data base. Carline classes are defined that contain cars with the following parameters in common: GM Division, Inertia Weight, CID-BBL, Transmission Type, and Axle Ratio. Within each carline class, harmonic mean fuel economics are computed for groups of cars with extreme ranges in each of eight seasonal, topographical, and geographical parameters. The dependence of fuel economy on these parameters is determined by comparing fuel economics between groups. Sales weighted harmonic mean fuel economies are computed for analogous groups at the division and fleet level. (Portions of this document are not fully legible)

39025 (PB—283952) **The energy cost of road and rail transport in Tasmania.** Perry, N.R.F.; Volframs, A. (Tasmania Univ., Hobart (Australia). Environmental Studies). 1977. 56p. NTIS PC A04/MF A01.

The purpose of this study was to undertake a detailed investigation into the energy used by the road and rail sectors of the Tasmanian transport system for the year 1974. In Section A, the energy used by road transport is examined in terms of the direct energy cost of fuels and also the indirect energy costs associated with motor vehicles and their support systems. Section B is concerned with the government railways and analyses the energy cost of fuel, rolling stock and railway lines. In each of these sections the relative efficiencies with which submodes perform their transport task are considered. The final section, Section C, compares the energy utilization of the Tasmanian transport system with the national average and that of other countries and considers some policies directed towards energy economies.

39026 (PB—283974) **Automated fuel dispensing for state and local governments.** (Public Technology, Inc., Washington, DC (USA)). 1977. Contract NSF-C834. 51p. NTIS PC A04/MF A01.

This report identifies the problem associated with fuel dispensing operations; indicates potential ways to overcome that problem; and provides guidance for the assessment of local need in that area and in the selection of alternatives to meet that need. It identifies the shortcomings of manual fuel dispensing systems and discusses the kinds of available automated systems.

39027 (PB—284941) **Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in Chicago, Illinois. Final report.** Liljedahl, D.R.; Terry, J. (Automotive Testing Labs., Inc., Aurora, CO (USA)). Jan 1977. Contract EPA-68-03-2378. 320p. NTIS PC A14/MF A01.

Emission and fuel economy tests were performed on a sample of one hundred individually-owned 1975 and 1976 model-year light-duty vehicles in the Chicago metropolitan area. Vehicles manufactured by Chrysler Corporation, Ford Motor Company and General Motors Corporation were represented somewhat equally. The purpose of these tests was to investigate emission and fuel economy performance of typical in-use passenger cars and to quantify the individual and combined effects of any observable defects, disablement and/or maladjustments on exhaust emissions and fuel economy. The investigation followed a test plan which consisted of two portions. All vehicles entered the first or Restorative Maintenance Evaluation portion. Certain vehicles that received a major tune-up and passed Federal Exhaust Emission Standards upon completion of the first portion proceeded into the second of Selective Malperformance Evaluation portion. The first test in the plan was conducted with the vehicle in its as received condition. Up to three additional tests were conducted in the first portion each of which was preceded by a restorative maintenance action. Vehicles that proceeded into the second portion were tested five or more times. Each of these tests was preceded by a selected maladjustment. Each test point consisted of the 1975 Federal Test Procedure Economy Test and five short cycle tests. A modest driveability evaluation was also included. (Portions of this document are not fully legible)

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 38906, 39657

ENERGY SOURCES

REFER ALSO TO CITATION(S) 38321, 38907

39028 (CONF-781244—1) **Proposed industrial energy data base for technical evaluation of alternative energy systems.** Barnes, R.W. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

From Workshop on design of industrial energy information systems; Hilton Head Island, SC, USA (6 Dec 1978).

US industry is faced with the need to make broad changes in their basic energy systems during the next several years. Natural gas and petroleum-based fuel oils, the present major fuels, are expected to become either increasingly expensive or restricted from industrial use. The response by industry will be to sustain or implement new energy-conservation programs and to convert to more-abundant energy sources. These actions will entail substantial capital investments, and the associated decision processes will require certain significant information inputs. This paper discusses the kinds of energy information required by industrial managers to make effective decisions concerning: management of energy use and supply, introduction of new energy technology, conversion to new manufacturing processes. Thi discussion covers energy accounting and auditing systems, significant technological and economic factors, and the pertinent external (to the industrial user) variables.

39029 (RLO—1830-T1) **Department of Energy workshop on industrial energy conservation reporting, Washington, DC, November 6—7, 1978.** (Washington Scientific Marketing, Inc., DC (USA)). 1978. Contract EY-76-C-06-1830. 108p. Dep. NTIS, PC A06/MF A01.

In the Annual Report of the Industrial Energy Efficiency Improvement Program, DOE identified several areas wherein the reporting system could be strengthened and set up six workshops for this purpose. The proceedings of the initial workshop held in Arlington, Virginia, November 6 and 7, 1978 are presented in this report. Industrial representatives expressed their views on the current reporting program as well as on approaches to future reporting. Discussions at the plenary and individual group (10) sessions are included. Suggestions for approaches to current reporting are presented in the following areas: definition and guidance, data submission, conservation measurement and reporting, efficiency measurement, disaggregation, and fuel switching. Suggestions for approaches to future reporting on maximizing conservation, fuel optimization, and factors related to reporting are also made. (MCW)

39030 **Energy use in the New Zealand textile industry.** Halliday, L.A.; Barker, G.V.; Stewart, R.G. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1977). 27p. (NZERDC—29).

This report covers an energy survey of the New Zealand textile industry carried out from November 1975 to November 1976. The survey determines the total energy usage of the New Zealand textile industry during 1975, and assesses the potential for energy conservation. The New Zealand textile industry was taken to include wool scouring and the processing of loose fiber into yarns, fabrics, and carpets. During 1975, the textile industry used 2621 TJ of fuel energy and 390 TJ of electrical energy. The total energy usage of 3011 TJ corresponds to 3.0% of the total energy demand of all New Zealand industry, or 1.1% of the total New Zealand consumer demand. The fuel usage of the textile industry is about half that of the freezing works, whereas its electricity usage is about a quarter. There is considerable scope for achieving fuel savings by following well-proven conservation practices. Electricity usage could be reduced by only a small amount.

39031 **Energy price levels and the economics of irrigation.** Johnson, B.B.; Henderson, P.A. Lincoln, NE; Univ. of Nebraska (1977). 27p. (NP—23730).

The potential impact of energy price increases on the profitability of irrigation from wells is examined. Specifically, energy costs are related to total production costs for various irrigation situations in Nebraska. The variables of pumping depth, energy sources, distribution systems and amounts of water pumped are combined to appraise the impact of potential energy price increases for specific situations. It is concluded that the impact of possible energy price increases is elusive and varies widely. In general, this analysis shows

that a 50% rise in current energy costs would increase corn production costs by 7 to 15%. The effect on profitability of corn production would depend on commodity prices, and the effect of this profitability on the continued use of energy-consuming irrigation methods must be carefully and continuously evaluated as energy costs increase. (LCL)

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 38834, 38939, 39015

39032 Energy-saving milk production. Using the heat of the milk for heating water. *Agrartech. Int.;* 56: No. 8, 15-16(Aug 1978). (In German).

In order to obtain milk which can be kept, it must be cooled within 3 h from 32 to 4°C. The heat removed from the milk can be used to operate a heat pump plant, which supplies the quantities of hot water required for cleaning purposes and may also cover the household consumption (of hot water). The article describes a plant which was produced, where the heat removed per kg of milk (26 to 31 kcal/kg) is used to heat water to about 50°C. By means of a calculation, whose main parameters are given, it is shown that the plant costs are amortised within 3 years with a herd of 50 cows.

39033 (PB—283950) **An energy analysis of Tasmanian barley, hops and beer production.** Kirkham, D.O.; Matthews, J.H. (Tasmania Univ., Hobart (Australia). Environmental Studies). 1977. 59p. NTIS PC A04/MF A01.

This study consists of a detailed examination of the energetics of production of two important Tasmanian agricultural crops - hops and barley. As these crops are grown primarily for the manufacture of beer, the study has been extended to include the energetics of production of this beverage which is a significant component of the average Australian diet. The objectives of this work were to gain some insight to identify the principal areas of high energy use; as such, this study forms part of a larger investigation into the energetics of primary and secondary production in Tasmania.

39034 (PB—283951) **Energy analysis of zinc production.** Middleton, G.J.; Patterson, I.G. (Tasmania Univ., Hobart (Australia). Environmental Studies). 1977. 39p. NTIS PC A03/MF A01.

This study examines the role of energy in the production of refined zinc in Tasmania. Section A of the report analyses the energy cost of mining and milling ore to produce zinc concentrate; the refining of the concentrate to produce zinc metal is the subject of further energy analysis in Section B. The outcome of these analyses is the net energy requirement (N.E.R.) for the production of one ton of zinc.

39035 Energy conserving fume hood. Duym, A. US Patent 4,142,458. 6 Mar 1979. Filed date 18 Nov 1977. 4p.

An enclosed fume hood having an access window with a vertically sliding sash is provided with an additional horizontally movable sash which closes off only a fraction of the open window space and thus reduces the volume of air required to be drawn through the window in order to maintain the requisite air velocity while still permitting complete access to the interior of the hood. Provision is also made to permit the horizontally movable sash to be easily removed, when necessary, to permit insertion into the hood of apparatus wider than the residual open window space.

39036 Low energy sign illumination system. Minogue, R.W. (to Federal Signal Corp.). US Patent 4,139,957. 20 Feb 1979. Filed date 22 Mar 1977. 6p.

A low energy sign contruction is illustrated for illumination of signs of the type having translucent illuminated faces. An opaque sign border is bridged by a reflector extending generally parallel to the illuminated face and having a truncated sawtooth profile. For single sided signs, one set of sawtooth points is truncated; for dual sided signs, both set of sawtooth points are truncated. Bayonet mounted lighting sockets are mounted at apertures in the respective truncations and utilize the metallic reflective surface as one side of a low voltage (10.5-volt) ac circuit. The reflector forms a cooled heat sink mounting the bulbs as well as a supporting matrix. The lamps, as mounted to this supporting matrix, are typically spaced at distances which do not exceed twice the distance of the lamp filament to the translucent face. By the expedient of using 14-V lamps, prolonged lamp life with low energy illumination results.

39037 Apparatus and method for drying seed corn by burning cobs. Stanfield, Z.A. (to Ciba-Geigy Corp.). US Patent 4,139,952. 20 Feb 1979. Filed date 12 Sep 1977. 12p.

The invention discloses an apparatus and method for drying seed corn using cobs and unusable seed corn as fuel for heating the drying medium. Products of combustion from an incinerator for incinerating cobs is supplied to a heat exchange medium circulating apparatus having a first heat exchanger and a series of second heat exchangers connected in parallel with each other and in series with the first heat exchanger, and a means for circulating a heat exchange medium through the circulating apparatus for heating the heat exchange medium. A plurality of ear corn dryers for drying seed corn in the form of ear corn each have a gaseous drying medium circulating apparatus control system for alternately circulating a gaseous drying medium in opposite directions through the dryers. Each drying medium circulating apparatus is connected to one of the second heat exchangers for recirculating the gaseous drying medium through the second heat exchanger after it has been circulated through the dryer. A sheller connected to the dryer receives the dried ear corn from the dryer and shells and the cobs are cycled to the incinerator as fuel therefor.

39038 Energy conservation in the New Zealand meat export industry. Pilling, R.G. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1977). 25p. (NZERDC—17).

The New Zealand meat industry has been confined to the production of meat products for export. The focal point is the export meat processing works which loaded out 93% of New Zealand's meat exports. Production by abattoirs has been excluded. The operations of farming and transport sectors were studied in relationship to these defined works. Data are presented on the consumption of fossil fuels and electricity by the New Zealand meat export industry in order to assist in the formation of priorities for conservation and self-sufficiency measures. The consumption of coal, petroleum fuels, and electricity by each sector of the meat industry is given. Comparisons are made between the North Island and the South Island. Coal is used by the processing works only, of which approximately three-quarters is used in the South Island. The farm sector consumed over half of the petroleum fuels and two-thirds of the electricity used by the meat industry. A detailed analysis of each sector's energy consumption and related physical operations is made. As examples the energy-inefficient movement of livestock from farms to the processing works and also that of transport of meat products to the loading ports are presented. Transport operators provide a link between farms, works, and ports and the diversity of movements is a consequence of supply and demand between these sectors. Conservation measures are outlined for each sector of the industry.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 39258

39039 (CONF-790443—2) **Overview of waste heat utilization techniques.** Olszewski, M. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From American power conference; Chicago, IL, USA (23 Apr 1979).

Power plants annually reject about 11 x 10^9 GJ (11 x 10^{15} Btu) of low-grade heat to the atmosphere. Typically, this heat is found in the large quantities of cooling water necessary to condense the steam in the power-generating cycle. Such cooling water is generally discharged in the range of 15 to 43°C (60 to 110°F) depending on the temperature of the available inlet water, quantity circulated, plant load, and heat-rejection system used. A number of possible uses have been suggested for this low-grade heat, including: greenhouse horticulture; soil heating (both open field and in greenhouses); spray irrigation for frost protection; organic waste treatment (particularly for algae or biomass production); and aquaculture/mariculture. To date greenhouse and aquaculture/mariculture systems have received the most attention and have, therefore, progressed farthest. This paper describes several innovative techniques that utilize power-plant reject heat for these applications. Schematic descriptions are given for these techniqes and a brief review of the project status is provided. The major efforts to utilize reject heat for agricultural purposes are described not only for the U.S., but efforts in Canada, France, West Germany, and the USSR are noted.

39040 (HCP/M5056—02) **Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States.** (Mechanical Technology, Inc., Latham, NY (USA)). Jul 1978. Contract EM-77-C-01-5056. 139p. Dep. NTIS, PC A07/MF A01.

Basic process data for the petroleum refining and selected chemical industries in the West South Central United States are compiled. The data is intended to provide a basis for subsequent study of the potential for heat pump applications to waste heat recovery in these industries. Nine petroleum refining processes and three chemical processes are analyzed in the report. Applicable information from related literature is presented, and comparisons are drawn to data obtained from four sample chemical plants and two sample petroleum refineries of the West South Central region. General conclusions are difficult to draw due to the variety of these industries, but considerations are presented to aid in assessment of proposed specific heat pump applications.

39041 (PB—285709) **Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report.** Incropera, F.P. (Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Sep 1978. 91p. NTIS PC A05/MF A01.

There has been considerable interest in recent years in controlling the thermal condition of shallow water bodies used to effect beneficial biological conversion processes. Waste heat from a power production process may be used as the energy source for this control, and specific applications include wastewater treatment and algal production. In this study mathematical models were developed to assess means of maintaining thermal control and assessing the impact on wastewater treatment and algal production. The thermal response and control of a shallow pond which uses waste heat in a closed cycle cooling system was considered. Calculations suggested a heat exchanger design involving a network of 30m long, 25mm OD pipes on 0.15m centers. The design provides a reasonable compromise between initial costs and performance and enables maintaining near-optimum pond temperatures throughout the year for climatic conditions typical of the midwest. Calculations based on a model of a completely mixed activated sludge wastewater treatment system revealed the benefits to be derived from operation at elevated temperatures. Effluent quality is improved for any increase in temperature from 10 to 30 C. Calculations based on a model of algal growth at optimum temperatures predicted daily yields which are in agreement with maximum yields which have either been measured or inferred from field studies.

39042 **Apparatus for hot gas heat transfer particularly for paper drying.** Cirrito, A.J. US Patent 4,146,361. 27 Mar 1979. Filed date 30 May 1975. 22p.

Regenerative compression-combustion-expansion cycle engines are utilized to generate hot, high pressure gases for heat transfer use. The gas generation equipment includes temperature modulation by water injection, recycle of spent gas, and injection of turbine-expanded gas into the main hot gas stream. Separate combustion chambers are also utilized for exploiting low-cost fuel and increasing gas temperature. Special heat transfer equipment including helical nozzle arrays are provided for paper drying, the nozzle arrays being arranged to indirectly heat materials, such as paper, being dried, to radiantly heat such material, and to directly heat such material by impinging hot gas directly thereon. Continuously cleaned rotary filters, as well as jet operated doctor blades may be used in association with the nozzles. Hot high pressure gases are also employed for water removal from paper and similar materials by being forced through wet paper carried between two felts, and equipment leading the gas to and away from such a felt-paper sandwich is provided. One embodiment of such equipment includes an impervious gas conducting belt. The use of hot high pressure gases as a source of flow and turbulent energy for heat transfer purposes results in extremely efficient heat utilization, and the heat transfer equipment exploits to the fullest the properties of such hot pressure gases to minimize film resistance to heat transfer.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 38086, 39561

39043 (PB—283694) **Reclamation and reuse of fruit processing wastewater.** Thompson, H.W.; Esvelt, L.A. (Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab.). 30 Jun 1978. 41p. NTIS PC A03/MF A01.

It is technically and economically feasible to renovate and reuse fruit cannery wastewater as a process water supply without adversely affecting product safety or quality. However, the chemical, physical and bacteriological quality of the renovated wastewater, along with consistency of quality, are critical in determining where this water can be reused within the processing facility. The wastewater reclaimed under this study contained no sanitary wastes. Study results indicate that it is feasible, at the test site, to reduce wastewater discharge and fresh water demand by over 50%.

39044 (PB—283695) **Water reuse in poultry processing.** Witherow, J.L.; Hamza, A.; Saad, S. (Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab.). 30 Jun 1978. 23p. NTIS PC A02/MF A01.

A comparison is made of the quality of process water and product with and without water reuse in a modern poultry processing plant in Egypt. The need for water reclamation prior to reuse is indicated. The technical and regulatory potential for water reuse in poultry processing in the U.S. is reviewed.

39045 (PB—284200) **Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974—June 1977.** Bucy, J.I.; Torstrick, R.L.; Anders, W.L.; Nevins, J.L.; Corrigan, P.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Apr 1978. 268p. NTIS PC A12/MF A01.

The report gives results of an evaluation of the market potential for sulfur and sulfuric acid byproducts of combustion in power plant boilers. (Air quality regulations require control of SOx emissions from power plant boilers. Recovery of sulfur in useful form would avoid waste disposal and conserve natural sulfur and natural gas used to mine sulfur.) A cost model was developed to estimate the least-cost compliance method from three alternatives: selecting a clean fuel strategy, selecting a limestone-throwaway scrubbing technology, or selecting a sulfuric acid or sulfur-producing scrubbing technology. For plants where production of byproducts was the economic choice, a market simulation model was used to evaluate distribution of byproducts in competition with existing markets. Significant amounts of sulfuric acid could be produced from SOx in power plant flue gas and sold in competitive markets.

39046 (PB—285437) **A study of the feasibility of utilizing solid wastes for building materials. phase iii and iv summary reports. Final report, September 1975—March 1978.** (Material Systems Corp., Escondido, CA (USA)). May 1978. Contract EPA-68-03-2056. 192p. NTIS PC A09/MF A01.

This report summarizes work to develop building materials containing inorganic and organic wastes and wastes-derived products. Attempts were made to produce full-scale products and qualify them for structural applications. Particle board panels were made of peanut hulls and wood waste on production-type equipment. Particle boards of peanut hulls have mechanical properties that are slightly less desirable than those of commercially available boards, and the economics are marginal. However, particle board panels of wood waste can be competitive with commercial products. Two hour, fire-rated structural walls made from inorganic rice hull foam could also be viable, as could floors, roofs, ceilings, and the 90-minute, fire-rated door with a rice-hull foam core and a wood-waste frame. These tests completed generation of the data required for building code approval.

39047 (PB—285797) **Engineering and economic analysis of waste to energy systems. Final report, April 1975—June 1977.** Wilson, E.M.; Leavens, J.M.; Snyder, N.W.; Brehany, J.J.; Whitman, R.F. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). May 1978. Contract EPA-68-02-2101. 460p. NTIS PC A20/MF A01.

Waste quantities and characteristics in the U.S. are reviewed and waste-to-energy conversion technology evaluated. All waste materials, exclusive of those from mining operations, are considered. The technology is reviewed under the categories of mechanical processing, biological conversion systems, thermal/chemical systems, and combustion. Important features of many operating facilities are described and detailed engineering and economic analyses of seven specific systems are presented. An analysis is also made of the technology and costs for conversion of pyrolytic off-gas to methane, methanol, and ammonia. Environmental pollution data are presented where available and the current control technology briefly reviewed. Conclusions on the conversion technology are made and research needs considered in a series of recommendations. (Portions of this document are not fully legible)

39048 (PB—286050) **NATO CCMS pilot study, disposal of hazardous wastes, phase 1. Final report.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). 1977. 37p. NTIS PC A03/MF A01.

In recognition of the growing importance of hazardous waste generation and disposal to environmental protection and economic development and considering that international cooperation could contribute effectively to a better understanding of the complex nature of the problems involved, the Pilot Study 'Disposal of Hazardous Wastes' was originally proposed by the Federal Republic of Germany at the 1973 CCMS Plenary. The proposal was made at a time when numerous environmentally unsound hazardous waste disposal activities were reported in most industrialized countries. There was an obvious need to improve the situation in that area. Governments of nearly all NATO countries recognized this challenge and responded by preparing or reviewing legislation and regulations to control the flow of hazardous wastes into the environment and to avoid further mismanagement. In this respect the proposed pilot study met special interest among NATO allies.

39049 (Y/DA—8220) **Biological denitrification of industrial strength nitrate wastes.** Taylor, P.A. (Oak Ridge Y-12 Plant, TN (USA)). Feb 1979. Contract W-7405-ENG-26. 19p. (CONF-790405—15). Dep. NTIS, PC A02/MF A01.

From AICE meeting; Houston, TX, USA (1 Apr 1979).

The design of biological denitrification systems for treating low concentration nitrate wastes is well established. However, since treatment of high-strength nitrate wastes has been quite limited, an experimental measurement of either the maximum denitrification rate or the minimum residence time will be required before design calculations can be completed. The experimental measurements should be made using the same nitrate waste composition and operating conditions (pH, temperature, etc.) as will be used in the

full-scale system. For nitrate wastes in the 1 to 3 wt % NO_3 concentration range, the minimum residence time requirement will be the conrolling parameter for scale-up calculations. The maximum denitrification rate (g NO_3/1/day) will be the controlling parameter for waste streams above 5 wt % NO_3, and both factors must be considered for intermediate concentrations.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 38869

39050 (PB—284198) **Energy conservation plan for the state of Louisiana. (Public Law 94-163 and 94-385).** (Louisiana Dept. of Natural Resources, Baton Rouge (USA)). Sep 1977. 201p. NTIS PC A10/MF A01.

Topic areas covered include: thermal and lighting efficiency standards for new buildings, lighting efficiency standards for existing public buildings, building energy audits, residential energy conservation, decorative gas lighting, master-metering, industrial energy conservation, natural gas tax credit repeal, energy efficient procurement practices in Government, carpool/vanpool promotion, right-turn-on-red, education and public awareness, and intergovernmental coordination.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 38937

39051 (PB—283860) **Science advisor report to Burbank City Council, 1975—1976.** Floyd, A.L. (Burbank City Council, CA (USA)). 30 Sep 1976. 31p. NTIS PC A03/MF A01.

Prior to this report, the City Council of Burbank authorized the appointment of a science advisor. This report covers all the activities since that appointment, particularly the progress that has been made by Burbank toward technical solutions to energy problems. The stated objectives of the project proposal were to: (1) demonstrate the operational feasibility of a program that would provide local governments that own and operate electric utilities a means for obtaining and applying technological resources to mitigate the potential electrical energy demand/supply imbalance; (2) contribute concretely to the mitigation of these demand/supply energy problems; (3) provide local government personnel training in the skills of technology development, transfer, and utilization; and (4) expose private industry to the potential market represented by local governments that need constant exposure to evolving technology over the coming decades. Programs emanating from these objectives included programs in conservation (load management and other conservation activities); programs in developing new sources of energy (geothermal); and programs in technology transfer.

39052 (PB—285656) **Planning water supply: cost-rate differentials and plumbing permits. Final report.** Goddard, H.C.; Stevie, R.G.; Trygg, G.D. (Cincinnati Univ., OH (USA). Dept. of Economics). May 1978. 215p. NTIS PC A10/MF A01.

This study is concerned with measuring the cost of water supply and net revenue differences among customers by user class and location, and analyzing future water demand on the basis of plumbing permit application data. For water supply, a methodology based upon engineering principles was employed to collect data on distance, altitude, and costs of water delivery to sampled customers in a water utility service area. Estimates of cost elasticity were obtained. Altitude was not significant, but distance was found positively correlated with cost. In one location, at an extreme of the service area, this total cost elasticity became greater than one. Thus, cost economies for transmission of water exist, but are limited as indicated by this cost elasticity estimate. In addition, these costs were compared to the revenues collected from each customer sampled. The pattern of costs and computed net revenues were then examined through the use of computer mapping techniques. All this information becomes useful for examining water rates and system expansion. Also examined is the hypothesis that future water use can be predicted through the use of plumbing permit records.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 39047, 39658

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 38902, 38930, 38932, 39012

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 39023, 39024, 39080, 39082, 39083, 39084, 39085

39053 (N—78-27532) **Utilization of waste heat in trucks for increased fuel economy.** Leising, C.J.; Purohit, G.P.; Degrey, S.P.; Finegold, J.G. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 May 1978. Contract NAS7-100. 41p. NTIS PC A03/MF A01.

Improvements in fuel economy for a broad spectrum of truck engines and waste heat utilization concepts are evaluated and compared. The engines considered are the diesel, spark ignition, gas turbine, and Stirling. The waste heat utilization concepts include preheating, regeneration, turbocharging, turbocompounding, and Rankine engine compounding. Predictions were based on fuel-air cycle analyses, computer simulation, and engine test data. The results reveal that diesel driving cycle performance can be increased by 20% through increased turbocharging, turbocompounding, and Rankine engine compounding. The Rankine engine compounding provides about three times as much improvement as turbocompounding but also costs about three times as much. Performance for either is approximately doubled if applied to an adiabatic diesel.

39054 (N—78-31428) **Automotive technology status and projections. Volume 1. Executive summary.** Dowdy, M.; Burke, A.; Schneider, H.; Edmiston, W.; Klose, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Jun 1978. Contract NAS7-100. 51p. NTIS PC A04/MF A01.

Fuel economy, exhaust emissions, multifuel capability, advanced materials and cost/manufacturability for both conventional and advanced alternative power systems were assessed. To insure valid comparisons of vehicles with alternative power systems, the concept of an Otto-Engine-Equivalent (OEE) vehicle was utilized. Each engine type was sized to provide equivalent vehicle performance. Sensitivity to different performance criteria was evaluated. Fuel economy projections are made for each engine type considering both the legislated emission standards and possible future emissions requirements.

39055 **Exhaust gas recirculation apparatus for an internal combustion engine.** Hibino, M.; Morishita, M. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,142,491. 6 Mar 1979. Priority date 9 Dec 1976, Japan, 8p.

An exhaust gas recirculation apparatus of the so-called exhaust gas pressure control type is described that includes in combination, a vacuum-operated pressure control valve adapted for controlling the pressure of the exhaust gas in the exhaust gas recirculation passageway connecting the exhaust manifold to the intake manifold, and a vacuum control valve adapted for controlling the level of the vacuum signal transmitted to the pressure control valve, for obtaining a predetermined constant pressure in the exhaust gas directed to the pressure control valve. A flow control valve is provided for controlling the amount of exhaust gas directed to the pressure control valve in accordance with the load of the engine. The flow control valve has an exhaust gas passageway with a constant flow area, and another exhaust gas passageway with a flow area that is varied in accordance with the load of the engine.

39056 (PB—283953) **Analysis of timing and carburetion calibrations. Final report.** Forrest, L.; Clifford, J.M.; Smalley, W.M. (Aerospace Corp., El Segundo, CA (USA)). Oct 1976. Contract EPA-68-01-0417. 230p. NTIS PC A11/MF A01.

This was a two-part study effort. In the first part, an evaluation was made of vehicle simulation computer programs to determine and select the best program for EPA use in conducting various analyses of automobile fuel economy and emissions effects. The programs considered were (1) a DOT simulation routine called VEHSIM, (2) a program developed by the University of Wisconsin, and (3) a program developed by The Aerospace Corporation. The DOT VEHSIM program was picked primarily because it provides exceptional flexibility and ease of operation, and because it appeared to be readily adaptable to modifications required for the analysis of timing and carburetion calibrations in part two of this study. The latter effort entailed the determination and calculation of factors representing the fuel economy influence of ignition timing and carburetor calibration differences in certification test vehicles. Using the VEHSIM program with auxiliary programs VSIMI and VSIMII, specific calculations were made for distributor and carburetor calibration curves representing equipment in 1976 model year cars. (Portions of this document are not fully legible)

39057 (PB—285381) **Investigation of turbo-dyne energy chamber (G:R:Valve trademark) - an air bleed device.** Hutchins, F.P.; Kranig, J.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Apr 1978. 22p. NTIS PC A02/MF A01.

This investigation involved the testing of an air bleed device, known as G:R:Valves (trademark), marketed by N.C. Industries. This test was done at the request of the Federal Trade Commission. Advertisements for this device claimed that it would 'lower exhaust contaminants,' improve fuel economy, etc. The test was done to evaluate actual results with advertisement claims. The test results are presented in tabular form.

39058 **Hot fuel gas generator.** Mahoney, F.G.; Harpman, W.B. (to Econo Fuel Systems, Inc.). US Patent 4,145,998. 27 Mar 1979. Filed date 24 Jan 1977. 6p.

The invention discloses a hot fuel gas generator for an internal combustion engine simultaneously vaporized gasoline and water in a multi-chambered heated pressure vessel having built in regulators for controlling pressure and volume and delivers the resulting superheated steam and gaseous fuel to the internal combustion engine downstream from the usual carburetor. A single device operating at a very high temperature, for example 1600°F, is used for the simultaneous vaporization of the fuel and water to develop desirable working pressure and volume. The high temperature steam and gaseous fuel positions the fuel molecules at the greatest degree of separation from each other providing the greatest opportunity for contact of the oxygen, the reacting species in the gaseous condition as chemical reactions occur only between particles at the atomic or molecular level and it is necessary for the reacting species to be in actual contact at the time of reaction. The hot fuel gas produced therefore enables complete combustion and the elimination of the atmospheric pollutants common in the operation of internal combustion engines and increases the energy obtained from the fuel.

39059 **Turbocharger lubrication and exhaust system.** Sarle, C.R. (to Wallace Murray Corp.). US Patent 4,142,608. 6 Mar 1979. Filed date 12 Oct 1976. 4p.

A turbocharger system is described. One impeller of the turbocharger is driven by exhaust gas from an internal combustion engine, the other impeller functions as a pump to either compress air or to pump air in order to convey granular material. The impeller wheels are spaced and are mounted at the ends of a common shaft. The shaft is continuously lubricated, the spent lubricant being fed to an oil sump (crankcase). The specific improvement is a pressure bleed passageway between the chamber which receives engine exhaust pressure and the oil exhaust line. The bleed allows a portion of engine exhaust to pass to the sump exhaust line and assist oil flow to the sump by virtue of a pressure differential. This action, in turn, inhibits spent oil from passing through the seals and passing into either or both impellers when oil sump (crankcase) pressure is higher than atmospheric or where there are unfavorable to gravity flow conditions existing in the oil return line. Another portion of the system bleeds air from a high pressure reservoir to the interior of the oil sump line to assist spent oil flow to the sump.

39060 **Feedback emission control for internal combustion engines with variable reference compensation for change with time in performance of exhaust composition sensor.** Asano, M.; Fujishiro, T.; Aono, S.; Hosaka, A.; Manaka, N.; Ezoe, M. (to Nissan Motor Co, Ltd.). US Patent 4,142,482. 6 Mar 1979. Priority date 9 Feb 1977, Japan, 12p.

Emission control apparatus for internal combustion engines is provided with a sensor for detecting the concentration of a particular exhaust composition in the emissions from the engine. A signal indicating the deviation of the mixture ratio from a controlled point is generated by comparing the output from the sensor with a reference level, the signal being modified in amplitude according to a predetermined control characteristic and used to regulate the air-fuel mixture ratio at the desired control point. The varying magnitude of the sensed concentration is smoothed into a signal of slowly varying magnitude which is used to control the reference level so that error introduced into the deviation indicating signal due to the change with time in the output performance of the exhaust composition sensor is self-compensated. A level sensor is provided to detect when the reference level reaches an end of the control range to change the operating mode of the engine from closed-loop to open-loop mode.

39061 **Fuel consumption measuring device.** Wolf, D.; Schultze, H. US Patent 4,140,009. 20 Feb 1979. Filed date 21 Oct 1976. 8p.

The invention relates to a device for measuring fuel consumption of liquid-fuel engines with variable power yield depending on operating conditions, especially the fuel consumption of automotive engines, characterized by one fuel metering unit each for return fuel flow and/or forward fuel flow, consisting of: a pair of circular chambers; a freely rotating gear, located within each said chamber; tangentially arranged holes extending into each circular chamber and acting as entry and outlet ports for fuel; a light transmitting component, located in the wall of each chamber and closing the chambers in the zones of the teeth of a ring gear; an infra-red transmitter and an infra-red receiver external to each chamber on one optical axis with the light transmitting components; and a measuring circuit connected to each infra-red receiver, and including a pulse transformer and a comparison circuit.

39062 **Fuel injection system.** Stumpp, G.; Grieshaber, H. (to Robert Bosch GmbH). US Patent 4,090,486. 23 May 1978. Priority date 7 Oct 1976, German, Federal Republic of (F.R. Germany), 6p.

The invention discloses a fuel injection system for externally ignited internal combustion engines in which a fuel metering and distributing valve is controlled by an air sensing element disposed in the air suction tube of the engine and by structure which is adapted to alter the restoring force exerted on the air sensing element through the fuel metering and distributing valve. The noted structure includes a control pressure conduit, a pressure control valve connected to the control pressure conduit and a further conduit for connecting the pressure control valve to the suction tube of the engine downstream of the butterfly valve. With this structure it is possible to alter the restoring force mentioned above so that a properly proportioned fuel-air mixture is achieved, and in particular, so that a properly enriched fuel-air mixture is achieved during full load operation.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 39009

39063 (N—78-31429) **Automotive technology status and projections. Volume 2. Assessment report.** Dowdy, M.; Burke, A.; Schneider, H.; Edmiston, W.; Klose, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Jun 1978. Contract NAS7-100. 414p. NTIS PC A18/MF A01.

Current and advanced conventional engines, advanced alternative engines, advanced power train components, and other energy conserving automobile modifications which could be implemented by the end of this century are examined. Topics covered include gas turbine engines, Stirling engines, advanced automatic transmissions, alternative fuels, and metal and ceramic technology. Critical problems are examined and areas for future research are indicated.

39064 (PB—285382) **Emissions and fuel economy testing of a Naval Academy heat balanced engine (NAHBE).** (Environmental Protection Agency, Ann Arbor, MI (USA)). Apr 1978. 28p. NTIS PC A03/MF A01.

Various efforts of Naval Academy researchers have been directed toward improving the combustion cycle of spark ignition engines. During the past several years they have developed a technique which is based on pressure exchange between two zones in the combustion chamber thereby achieving a heat balanced cycle (NAHBE) which supposedly combines the best characteristics of the Diesel and Otto cycles. In 1977 EPA was requested to test an engine modified to the NAHBE configuration. Due to the required break-in of new engines, the testing was done in early 1978. The tests involved characterizing the fuel economy and emission of the test engines under operating conditions.

39065 (PB—286075) **Performance characteristics of automotive engines in the United States. First series - Report No. 15. 1975 Dodge Colt 98 CID (1.6 liters), 2v. Interim report, August 1977.** Chamberlain, T.W.; Koehler, D.E.; Stamper, K.R.; Marshall, W.F. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). May 1978. 41p. NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Dodge Colt 1.6 liter (98 CID) engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

39066 (PB—286076) **Performance characteristics of automotive engines in the United States. Second series - Report No. 5. 1977 Ford 140 CID (2.3 liters), 2v. Interim report, November 1977.** Chamberlain, T.W.; Koehler, D.E.; Stamper, K.R.; Marshall, W.F. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). May 1978. 62p. NTIS PC A04/MF A01.

Experimental data were obtained in dynamometer tests of a 1977 Ford 2.3 liter (140 CID) engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

39067 (PB—286077) **Performance characteristics of automotive engines in the United States. Third series - Report No. 1. 1977 Volvo 130 CID (2.1 liters), f. i. Interim report, November 1977.** Koehler, D.E.; Stamper, K.R.; Marshall, W.F. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). May 1978. 46p. NTIS PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1977 Volvo 130 CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

39068 **Electric fuel injection valve.** Casey, G.L.; Tuller, B.H. (to Bendix Corp.). US Patent 4,142,683. 6 Mar 1979. Filed date 17 Mar 1977. 30p.

A single point fuel injection system for an internal combustion engine is described that includes a throttle body having first and second air intake throats corresponding to first and second intake manifold planes of the engine, the air flow through each throat being controlled by throttle plates positioned within each throat. The throttle body further includes a fuel accumulating bowl which is integrally formed with the throttle body, the bowl being enclosed by a diaphragm and cover member. Within the enclosure of the fuel bowl are positioned a pair of injectors which are adapted to inject pulsed portions of fuel through a sonic nozzle and into the air intake throat of the throttle body. The injection of pulses of fuel into the throat is timed in accordance with the sensing of the crankshaft reaching a position of 15° before top dead center to enhance the distribution of fuel charge from cylinder to cylinder. The fuel pressure within the bowl is controlled by a pressure regulator positioned within the enclosure formed by the bowl and housing cover, the diaphragm closing the bowl also forming the diaphragm for the regulator. The pulses to the injectors are controlled by an electronic control unit in response to sensed engine conditions.

39069 **Fuel-oil mixing apparatus for internal-combustion engines.** Schreier, J.S. US Patent 4,142,486. 6 Mar 1979. Filed date 6 Sep 1977. 10p.

An oil reservoir separate from a fuel tank is provided with an expandable chamber assembly and a positive displacement pump which are jointly operated in an opposed tandem relationship. The chamber assembly is used to supply mixed fuel and oil on demand to the engine fuel intake. The positive displacement pump draws measured amounts of oil from the reservoir during each stroke cycle and injects this measured amount into the incoming fuel in the chamber assembly. As one moves through its suction stroke, the other moves through its delivery stroke. The ratio between the volume displacement of the pump relative to the volume displacement of the expandable chamber assembly is equal to the desired volume ratio of oil to fuel at the engine fuel intake. The oil and fuel are thoroughly mixed as they are delivered from the apparatus.

39070 **Turbocharged engine with vacuum bleed valve.** Negri, J.M.; Wallace, T.F. (to General Motors Corp.). US Patent 4,142,494. 6 Mar 1979. Filed date 3 Oct 1977. 8p.

The turbocharged internal combustion engine has a carburetor fuel metering control rod, an ignition timing control member, an exhaust gas recirculation control pintle, and an induction air temperature control damper operated in response to vacuum signals created by the pressure in the induction passage between the throttle and the turbocharger compressor and a valve which bleeds the vacuum signals to atmospheric pressure when the compressor discharge pressure rises above a selected value to establish a rich air-fuel mixture, retard ignition timing, inhibit exhaust gas recirculation and provide cool induction air flow for maximum power operation.

39071 **Influence of overall fuel—air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine.** Sinnamon, J.F. Ann Arbor, MI; Univ. of Michigan (1978). 197p. University Microfilms Order No. 78-13,736.

Thesis (Ph. D.).

A CFR L-head engine was converted to a 3-valve, divided-chamber, stratified-charge engine. The engine permits insertion of an electromagnetically actuated sampling valve at any point in the combustion chamber, and also permits high-speed motion picture photography of the combustion process through a transparent cylinder head. The effects of overall fuel-air ratio and degree of stratification were studied by first operating the engine with a homogeneous fuel—air charge at a given fuel—air ratio. The prechamber was then progessively enriched while the main chamber was leaned to maintain constant overall fuel—air ratio. This procedure was repeated for values of overall fuel—air ratio from stoichiometric down to the lean limit of operation while power, emissions and fuel consumption were measured.

DIESEL

39072 (AD-A—059534) **High sulfur fuel effects in a two-cycle high speed army diesel engine. Interim report Oct 76-May 78.** Frame, E.A. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). May 1978. Contracts DAAK70-78-C-0001;DAAG56-76-C-0003. 149p. NTIS PC A07/MF A01.

The effects of increasing the fuel sulfur content while using a constant lubricant (MIL-L-2104C) were determined. Key areas of engine distress were identified and baselines were established using high (1.0%w) and low (0.4%w) sulfur fuels. Effects of more frequent oil drain intervals were determined.

TURBINE

REFER ALSO TO CITATION(S) 39063

39073 (AMMRC-TR—79-11) **Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977—March 1978.** McLean, A.F.; Baker, R.R. (Ford Motor Co., Dearborn, MI (USA)). Feb 1979. Contract EY-76-C-02-2630. 108p. Dep. NTIS, PC A06/MF A01.

Progress of previous work on reaction bonded and hot pressed silicon nitride materials technology is summarized. Improvements to the hot press bonding process resulted in a significant improvement in the yield of flaw-free hot press bonded rotors. Modulus of rupture and cold spin tests of rotor blade rings revealed the presence of undetected subsurface flaws in both the blades and the rim. Blade bend testing indicated that blade strength degraded during hot press bonding. An investigation of hot press bonding temperatures and time at temperature defined a region of zero microstructural and strength degradation. Using 19 hot press bondings, curves were generated defining the changes in color, porosity, hardness, phase and strength as a function of time and temperature. Improvements in injection molding of rotor blade rings were made utilizing an adaptive process control unit which controlled and monitored the injection velocity and die cavity pressure during the injection and hold portions of the molding cycle. Microfocus x-ray results indicated that high injection flowrates combined with low holding pressures in the die cavity reduced the number of subsurface void-type blade flaws. The detection of planar flaws in both green as-molded and nitrided blade rings revealed that this type flaw was only detectable after nitriding, indicating that it may only occur after burn out and/or nitriding. Approximately 30 experiments were conducted utilizing glass and/or metals as isostatic hot pressing media. Decomposition of the glass was minimized with vycor utilizing boron nitride as a barrier material. A reliability analysis was conducted for individual loading conditions. Recommendations for follow on work are presented.

39074 (N—78-27046) **CTOL transport technology, 1978.** (National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Jun 1978. 516p. NTIS PC A22/MF A01.

No abstract available.

39075 **Gas turbine.** Davis, D.A. (to Ford-Werke A.G., Koeln (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,514,028/A/. 23 Oct 1975. 6p. (In German).

By means of a reduced share of noxious constituents in the exhaust gas this gas turbine is to facilitate the application especially in road vehciles. The plant consists essentially of the turbine with a coupled compressor, a heat exchanger, 2 independent combustion chambers, one of which is provided with a supply air fan, and may be operated in 3 variants by alternating or common operation of the two combustion chambers. While during transient operation with both combustion chambers the working gas is heated very high, during operation with only one fired combustion chamber the temperature is lower, resulting in less production of nitric oxide. The release of pollutant gas is optimized towards a lower bound value by operation in the appropriate mode, i.e. by connecting and disconnecting of the two combustion chambers and by control of them.

ELECTRIC-POWERED SYSTEMS

39076 (AD-A—059365) **The application of optimal control theory to hybrid electric transit systems. Master's thesis.** Keane, M.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Oct 1977. 138p. NTIS PC A07/MF A01.

In an effort to minimize energy losses through the optimal control of an electric rapid transit system, three vehicle/flywheel configurations are modeled using the bond graph technique. Field and armature control of an on-board flywheel are presented along with field control of a station flywheel used in conjunction with a

typical regenerative vehicle. Pontryagin's Minimum Principle is used to develop the optimal control trajectories for vehicle accelerations and decelerations. The time integral of mechanical and electrical losses is minimized as the cost function. Armature control of the hybrid vehicle and field control of the station flywheel are equally efficient in the reversible energy flow between vehicle and flywheel. Field control of the hybrid vehicle is slightly less efficient. The optimal trajectory for deceleration is nearly linear, but the optimal trajectory for acceleration, due to the effect of mechanical losses over a longer time period, is highly concave and differs radically from a typical transit acceleration. The vehicle weight and resistance in the armature windings have a large influence on system performance.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 39076

VEHICLE DESIGN FACTORS

BODY AND CHASSIS

REFER ALSO TO CITATION(S) 39139

39077 Second international conference on vehicle structural mechanics. Structural analysis of the vehicle design process. Warrendale, PA; Society of Automotive Engineers, Inc. (1977). 266p. (CONF-7704100—). $30.00.

From Conference on vehicle structural mechanics; Southfield, MI, USA (18 Apr 1977).

Twenty-four papers on analytical methods for performing structural analyses of vehicles in order to optimize the safety, weight, and other aspects of vehicle design were presented at the conference. (LCL)

ENGINE SYSTEM

39078 Piston ring scuffing. London, England; Institution of Mechanical Engineers (1976). 229p. (CONF-7505149—). Mechanical Engineering Publications Ltd., P.O. Box 24, Northgate Ave., Bury St. Edmunds, Suffolk, England.

From Piston ring scuffing conference; London, UK (13 May 1975).

Fifteen papers on engine piston ring wear, and the role of dynamic, metallurgical, and lubrication factors in this wear are presented. (LCL)

EMISSION CONTROL

REFER ALSO TO CITATION(S) 38983, 39054, 39055, 39065, 39066, 39067

39079 (PB—285611) **Research on control technology for ice fog from mobile sources.** Coutts, H.J.; Turner, R.K. (Corvallis Environmental Research Lab., College, AK (USA). Arctic Environmental Research Station). May 1978. 98p. NTIS PC A05/MF A01.

Automotive generated ice fog is a form of air pollution that results when exhaust water vapor freezes into minute particles which form a dense fog. The major control technique evaluated was cooling the exhaust gases to well below the dew point, thus condensing water vapor into a liquid stream before final discharge. During the winters of 1974-75 and 1975-76 the Arctic Environmental Research Station evaluated 12 cooler-condensers on nine inservice vehicles. It was found that ice film formation decreased heat transfer efficiency. An ice fog mass emission reduction up to 80 percent was attained with cooler-condensers on motor vehicles. However, the increase in visibility over roads was not proportional because of the many other ice fog sources. The overall impact of automotive ice fog control would be a visibility increase of at least 70 percent in areas where motor vehicles create 50 percent or more of the ice fog. Control of automobile-generated ice fog would also mean cleaner air, but perhaps more ice on the road. Cleaner air would result because sulfur oxides and lead compounds would be absorbed in the condensate. This condensate, if allowed to drip from the cooler-condensers, would freeze onto the road and require a more intense snow removal effort.

39080 Device for controlling the composition of the exhaust gases from a heat engine. Poullot, B. (to Automobiles Peugeot). US Patent 4,145,881. 27 Mar 1979. Priority date 30 Dec 1976, France, 2p.

The invention improves the regulation of the composition of the exhaust gases in the case of engines having a plurality of rows of cylinders each of which rows is associated with an exhaust pipe. For this purpose, small-section pipes respectively lead from the exhaust pipes and have a common junction at which the analyzing probe is located. This junction is connected to the exhaust manifold preferably by way of a pipe which serves also to heat the induction pipe of the engine.

39081 Catalytic apparatus. Rosynsky, V.; Stawsky, A. (to Engelhard Minerals and Chemicals Corp.). US Patent 4,142,864. 6 Mar 1979. Filed date 31 May 1977. 10p.

The invention discloses a catalytic, gas treating apparatus in which a unitary ceramic catalytic element having gas flow passages therethrough, is positioned within a metallic casing in a manner providing a space between the casing and the catalytic element. A resilient member which is compressible both radially and longitudinally is positioned around the catalytic element in the space to resiliently hold the catalytic element. A plug member is positioned at least partially in the space, and, for instance, around the catalytic element at opposite end portions of the catalytic element, in a manner which longitudinally compresses said resilient member to a substantial extent to increase the holding force exerted on the catalytic element by the resilient member and thereby inhibit axial movement of the catalytic element during use. The device avoids the necessity of providing end flanges extending from the casing and overlapping the periphery of the end faces of the catalytic element for the purpose of minimizing axial movement of the catalytic element, and, as a result, essentially all of the gas flow passages remain available to the flow of the gas to be treated and there is maximum catalyst utilization.

39082 Elastic mounting for a catalytic converter in an internal combustion engine. Gaysert, G. (to J. Eberspacher). US Patent 4,143,117. 6 Mar 1979. Priority date 16 Dec 1972, German, Federal Republic of (F.R. Germany), 6p.

In an internal combustion engine, a catalytic converter is elastically mounted within a tubular housing in the radial and axial directions by hollow rings. The hollow rings are located at each end of the catalytic converter and are formed, at least in part, of a thin metal foil skin or shell enclosing an elastic material such as a wire mesh or a fibrous ceramic material. Various shapes of hollow rings can be used, for instance, a single L-shaped ring can provide both radial and axial mounting at one end of a catalytic converter or a pair of oval-shaped hollow rings can be employed at one end with one ring providing radial mounting and the other ring affording axial mounting.

39083 Exhaust gas purification system. Kobayashi, K.; Yokooku, K.; Nomura, K. (to Toyo Kogyo Co., Ltd.). US Patent 4,142,492. 6 Mar 1979. Priority date 4 Oct 1976, Japan, 12p.

The invention discloses an exhaust gas purification system for use in an internal combustion engine equipped with a dual exhaust system. The exhaust gas purification system includes a secondary air supplying port of a secondary air supplying passage opened into selected one of a first or second group of exhaust pipes, while an exhaust gas deriving port of an exhaust gas recycling passage for deriving port of an exhaust gas to an upstream of the carburetor throttle valve is provided in the exhaust line at a donwstream from the above secondary air supplying port for effective suppression of NO/sub x/ through accurate control of the amount of exhaust gases to be recycled.

39084 Engine exhaust gas recirculation system with periodic recalibration of exhaust back pressure reference. Lahiff, J.E. (to General Motors Corp.). US Patent 4,142,495. 6 Mar 1979. Filed date 5 Dec 1977. 6p.

The invention discloses an exhaust gas recirculation system in which the flow of recirculated exhaust gas is controlled through an orifice having exhaust back pressure on one side and a control pressure on the other, determined by an EGR valve. Apparatus is provided for sensing the control pressure and controlling the EGR valve in response to the sensed control pressure, a predetermined desired control pressure and a reference. At selected occurrences of engine idle, the EGR valve is closed and the sensed control pressure, which at such times is substantially the same as the exhaust back pressure at idle, is stored for use as the reference between said occurrences.

39085 Exhaust gas recirculation system. Saito, N.; Ohnishi, A. (to Nissan Motor Co., Ltd.). US Patent 4,142,496. 6 Mar 1979. Priority date 5 Apr 1976, Japan, 14p.

Two thermally operated control valves which, in cooperation with each other, admit into the vacuum chamber of a diaphragm unit for the EGR control valve atmospheric air only during cold engine operation, both atmosphere air and engine suction vacuum during engine warming-up operation, and engine suction vacuum only during engine normal operation.

39086 Method of treating vehicle exhaust gas and catalyst used therein. Baresel, D.; Scharner, P.; Huth, G. (to Robert Bosch GmbH). US Patent 4,140,749. 20 Feb 1979. Priority date 18 Jun 1976, German, Federal Republic of (F.R. Germany), 6p.

The present invention provides a catalyst for converting the noxous CO, NO/sub x/ and hydrocarbons found in the exhaust gases from internal combustion engines into less harmful gases, and to the method of treating said exhaust gases. The catalyst consists essentially of a solid solution of Fe_2O_3, Cr_2O_3, and Fe_3O_4. The catalyst may be extended on a porous carrier such as aluminum oxide or aluminum silicate. The catalyst is particularly suited for treating the exhaust gas from internal combustion engines of motor vehicles.

39087 Modeling of the catalytic converter for automotive exhaust gas. Pereira, C.J. Notre Dame, IN; Univ. of Notre Dame (1978). 221p. University Microfilms Order No. 78-21,652.

Thesis (Ph. D.).

The catalyst converter is considered from a chemical reactor theory viewpoint. Modeling is confined to the constituent elements of the packed bed and monolith converters; the problem involves diffusion and reaction of a reactant species in a single catalyst pellet or a tube-wall reactor.

NITROGEN OXIDES

39088 (PB—284095) Catalytic control of NO/sup x/ demonstration. Final report. Steiner, R.R. (Gould, Inc., Cleveland, OH (USA). New Business Div.). Apr 1977. Contract EPA-68-03-2161. 371p. NTIS PC A16/MF A01.

This report presents the results of a program that was intended to demonstrate the emission control benefits of catalytic reduction of NOx. The program objectives included the outfitting of three vehicles with catalytic systems and the accumulation of 50,000 miles of durability operation. The system selected was the Gould dual catalyst system. This system included a base metal (Ni-Cr alloy) reduction catalyst, a conventional noble metal oxidation catalyst, programmed secondary air injection, modified carburetion and revised spark timing. This system was installed in three 1975 Chevrolet Novas. Prior to the start of testing, it was discovered that the base metal catalyst formulation was susceptible to chemical attack and depletion by sulfur impurities present in typical pump gasoline. The program was held in abeyance while Gould attempted to develop a sulfur resistant formulation. Gould succeeded in developing a formulation with increased resistance to the sulfur impurities in fuel; however, a corresponding reduction in catalytic activity prevented the achievement of the 0.4 NOx emission level. The decision was then made to terminate the contract and prepare a final report which would present the work accomplished under the contract. (Portions of this document are not fully legible)

ALTERNATIVE FUELS

39089 (BETC/RI—79/2) Ethanol/gasoline blends as automotive fuel. Allsup, J.R.; Eccleston, D.B. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). May 1979. 17p. Dep. NTIS, PC A02/MF A01.

Vehicle tests were conducted to determine the influence of ethanol in a 10% ethanol/90% gasoline fuel mixture on fuel economy, regulated and unregulated exhaust emissions, exhaust hydrocarbon distribution, and road octane quality. Volumetric fuel economy was shown to be slightly decreased while energy economy was slightly increased using the ethanol/gasoline blend compared to gasoline. When compared to the base gasoline, the use of the ethanol/gasoline blend caused no deleterious effects upon regulated emissions at ambient temperatures from 20 to 75°F; at 100°F ambient there were minor increases in emissions using the ethanol/gasoline blend. The ethanol/gasoline blend generally had either no effect on or reduced all unburned hydrocarbon components except at the 100°F test condition compared to gasoline. Road octane quality was shown to be increased by the use of the ethanol-gasoline blend compared to gasoline.

39090 (SERI/SP—33-140) Generator gas: the Swedish experience from 1939—1945. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1979. Translation of GENGAS. 334p. Dep. NTIS, PC A15/MF A01.

The book summarizes the scientific, technical, and commercial information developed during World War II when Sweden, cut off from fossil fuels, converted 40% of its entire motor vehicle fleet to burning wood. Topics discussed include: (1) history; (2) the theory of gas generation; (3) generator gas fuels; (4) shape and design of the gas generator; (5) cooling and cleaning of generator gas; (6) adoption of generator gas for motor operation; (7) adaptation of engines to generator gas operation; (8) gas generator installation; (9) garage and service; (10) practical operating experience; (11) the economics of generator gas operation; and (12) the hazards of generator gas operation.

MATERIALS

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 38681, 38972

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 38686

39091 (COO—2960-3) Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978—31 May 1979. Devereux, O.F. (Connecticut Univ., Storrs (USA). Inst. of Materials Science). Feb 1979. Contract EY-76-S-02-2960. 43p. Dep. NTIS PC A03/MF A01.

Work is reported on thermodynamic analysis of gasifier models, equilibrium calculations performed on two and thre phase equilibrium involving components of coal gas, sodium salts, and carbon. Electrode polarization studies in molten sodium carbonate and polarization tests were performed on iron, steel, nickel, and on 304 and 316 stainless steel in molten sodium carbonate under a variety of exploratory environments. Gas/metal reactions studies, initial evaluation studies iron in hydrogen-hydrogen sulfide mixtures, pertaining to a new gravimetric facility are presented. Evaluation was made of reaction kinetics from polarization. A visual regression procedure utilizing interactive computer graphics is described for the fitting of multiparameter, nonlinear equations to experimental curves.

39092 (ORNL/TM—6711) Electron-beam welding of thorium-doped iridium alloy sheets. David, S.A.; Liu, C.T.; Hudson, J.D. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A03/MF A01.

Modified iridium alloys containing 100 ppM Th were found to be very susceptible to hot-cracking during gas tungsten-arc and electron-beam welding. However, the electron-beam welding process showed greater promise of success in welding these alloys, in particular Ir—0.3% W doped with 200 ppM Th and 50 ppM Al. The weldability of this particular alloy was extremely sensitive to the welding parameters, such as beam focus condition and welding speed, and the resulting fusion zone structure. At low speed successful electron-beam welds were made over a narrow range of beam focus conditions. However, at high speeds successful welds can be made over an extended range of focus conditions. The fusion zone grain structure is a strong function of welding speed and focus condition, as well. In the welds that showed hot-cracking, a region of positive segregation of thorium was identified at the fusion boundary. This highly thorium-segregated region seems to act as a potential source for the nucleation of a liquation crack, which later grows as a centerline crack.

39093 (SAND—79-0352C) Role of surface contaminants in the deformation welding of gold to thick and thin films. Jellison, J.L.; Wagner, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790506—2). Dep. NTIS, PC A02/MF A01.

From 29. electronic components conference; Cherry Hill, NJ, USA (14 May 1979).

The role of organic surface contaminants in the deformation welding of gold to thick and thin film conductors was investigated, employing shear tests to determine the strength of ball bonds. As was observed earlier for gold thin films, organic surface films play a dominant role in the deformation welding of gold to gold thick films. Gold thick films were found to be more tolerant to organic surface films than film gold. The contaminants evaluated (beeswax, halocarbon wax, and petrolatum) all degraded the weldability of gold more than atmospheric contamination. The gold—platinum thick films required higher temperatures than the gold metallizations for thermocompression welding.

39094 (SAND—79-0727C) Study of precipitation phenomena in aluminum alloys by positron annihilation. Wampler, W.R.; Gauster, W.B. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790437—3). Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

To assess the sensitivity of positron annihilation (PA) to precipitation phenomena, the Doppler broadened PA lineshape was monitored as a function of isochronal annealing steps on a series of

quenched aluminum alloys. A study of the Al—Cu system, including both PA and transmission electron microscopy, provided new information on the role of vacancies in the formation of Guinier—Preston zones and led to the conclusion that incoherent precipitate-matrix interfaces can provide efficient trapping sites for positrons. Further PA measurements on $AlMg_2Si$ samples showed that the lineshape parameter changes coincided with microstructural changes during annealing deduced from other techniques and indicated that PA provides a sensitive monitor of these phenomena.

39095 (SAND—79-0922C) **Observations of the vacuum arc and metal transfer during vacuum consumable arc remelting.** Zanner, F.J. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 11p. (CONF-790442—8). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

Observations have been made using high speed color photography of the vacuum arc and electrode surfaces during vacuum consumable arc remelting of a maraging steel alloy. Events on the film are coordinated with electrical signals from the vacuum arc. Based upon electrical observations, it was concluded in a previous investigation that metal transfer occurs when liquid metal spikes hanging from the cathode form a low resistance bridge (drop short) by touching the anode and then subsequently rupture. This recently proposed mechanism was visually verified with the exception that actual column rupture occurs after arc re-ignition and not at the instant of re-ignition. Observations have also shown that cathode spot accumulation (attack) plays an important role in impeding metal transfer and that transfer occurs primarily by a bulk type process. Thus, inclusions and any solid particles are transferred with the bulk.

39096 (UCRL—82528) **Precision machining vs. optical process.** Pearson, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Mar 1979. Contract W-7405-ENG-48. 8p. (CONF-790436—1). Dep. NTIS, PC A02/MF A01.

From SIRA-NPL conference on advances in optical production technology; Teddington, Middlesex, UK (24 Apr 1979).

High multiples of advantage in both time and cost make the emerging technology of advanced precision machining attractive as a fabrication process for a class of optical parts. The capability of the numerical control machine tool to cut complex geometries allows functional design improvements of optical elements over what is economically feasible by conventional optical process. Machining optical parts, however, is limited to materials amenable to the diamond tool bit, which excludes glass and ferrous metals, but includes ductile metals, plastics and a number of other materials suitable for optical elements.

39097 (Y/DA—8239) **Computer automation of an electron-beam welder.** Davenport, C.M. (Oak Ridge Y-12 Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 23p. (CONF-790435—1). Dep. NTIS, PC A02/MF A01.

From CAM-I international spring seminar; New Orleans, LA, USA (9 Apr 1979).

An existing Hamilton Standard 7.5-kW electron-beam welder has been upgraded and computer automated for precision production welding of parts of revolution. The new unit can repeatably produce multipass, wirefed welds on a time scale which is too fast for a manual operator's responses. Extensive rebuilding or replacement was required for nearly all the original equipment on the unit. A PDP-11/50 computer was installed to provide automatic sequencing through a weld procedure, as indicated in a specified stored file. Storage, editing, and listing of weld procedure files are provided by means of simple computer terminal inputs.

39098 **Application of matrix isolation spectroscopy to the measurement of sputtering yields.** Steinbruechel, C.; Gruen, D.M.; Dawson, J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Vac. Sci. Technol.;* **16**: No. 2, 251-254(Mar 1979).

Matrix isolation spectroscopy has been used to measure sputtering yields of D^+ and Ar^+ on Au and Ti in the energy range 0.25—2.0 keV. The technique involves bombarding a target with ions produced by a sputter ion gun, collecting sputtered atoms in a cryogenic noble gas matrix, and determining the amount of metal collected by optical spectroscopy. The present preliminary results are compared with previous results obtained by more conventional experimental techniques.

39099 **Ion nitriding of titanium and zirconium by a dc-glow discharge method.** Liu, M.B.; Gruen, D.M.; Krauss, A.R.; Reis, A.H. Jr.; Peterson, S.W. (Argonne National Lab., IL). *High Temp. Sci.;* **10**: No. 1, 53-65(Mar 1978).

Nitrided surfaces of titanium and zirconium were prepared by operating a dc-glow discharge in a mixture of 20% N_2 and 80% H_2 at 20 to 40 Torr. The discharge was confined between a stainless steel anode and the sample at about 500 mA with a dc potential of 360 to 400 V. The temperature of the sample was about 900°C. The kinetics of metal nitride formation are enhanced by about a factor of three in the dc discharge technique compared with either rf discharge of thermal nitriding methods. The golden-yellow nitrided surfaces were characterized by energy-dispersive x-ray and electron diffraction techniques. The results show that the nitrided surfaces contain mononitride phases. Depth-profile measurements were performed by argon-ion etching and surface analysis by means of XPS. The kinetics of the formation of surface nitride layers are discussed in terms of a reaction involving nitrogen—hydrogen molecular ions with the substrate. Diffusion of nitrogen into the bulk determines the rate of growth of the nitride layer. 20 references.

39100 **TIG and plasma welding.** Cambridge, England; Welding Institute (1978). 55p.

TIG and plasma welding processes have found increasing application in production where precision and/or high integrity are demanded. The fundamental operating characteristics operating modes, and development are described. The applications and experiences in welding components and structures in the chemical, nuclear and aeroengineering are discussed. (FS)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 39094, 39128, 39160, 39227

39101 (BDX—613-2165) **Pulse plating of hard gold electrodeposits.** Stimetz, C.J.; Hren, J.J. (Bendix Corp., Kansas City, MO (USA)). Feb 1979. Contract EY-76-C-04-0613. 16p. (CONF-790450—1). Dep. NTIS, PC A02/MF A01.

From International symposium on pulse plating; Boston, MA, USA (19 Apr 1979).

The conventional and pulse plated, cobalt hardened gold deposits were evaluated and differences in cobalt chemical composition, morphology, and microstructure were determined. Cobalt hardened gold samples were plated on polished brass substrates for morphology study. For microstructure and chemical composition the substrate was stainless steel-304.

39102 (CONF-790341—1(Draft)) **Observation of superstructure in α—U near 43 K.** Smith, H.G.; Wakabayashi, N.; Crummett, W.P.; Nicklow, R.M.; Lander, G.H.; Fisher, E.S. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). Mar 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

A lattice dynamics study of a α—U at room temperature revealed a pronounced dip in the Σ_4 LO mode at wavevector zeta = 0.475. Additional studies at low temperatures showed this mode to soften considerably. Below 60 K elastic peaks appear near (h + 1/2, k,l), increasing in intensity to a maximum at 10.4 K, the lowest temperature studied. The current tentative interpretation is the coexistence of two phases of uranium, the α phase, and a similar, but slightly distorted, α′ phase with a sinusoidal modulation in the x-direction.

39103 (UCRL—81879) **Correlation between acoustic emission and microstructure in aluminum alloys.** Bunch, R.; Hamstad, M.A.; Mukherjee, A.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1978. Contract W-7405-ENG-48. 10p. (CONF-790409—2). Dep. NTIS, PC A04/MF A01.

From ASNT spring conference; San Diego, CA, USA (2 Apr 1979).

During the past few years several new aluminum alloys have been introduced, either commercially or on an experimental basis. These new alloys were developed to improve the fracture toughness of some high-strength alloys that have been in commercial use for a number of years. Because research has shown that the content of inclusion particle impurities plays a major role in determining the fracture toughness of several 2000- and 7000-series aluminum alloys, part of the effort to improve the fracture toughness of the new alloys has been to reduce their content of impurities, especially elements such as iron and silicon.

39104 **LEED analysis of the reconstructed Au(110) surface.** Noonan, J.R.; Davis, H.L. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 587-589(Mar 1979).

The LEED I—V profiles for six inequivalent nonspecular diffraction beams from a Au(110) - (1 x 2) surface have been measured, with the incident beam at normal incidence, and compared with model calculations. The experimental curves are compared with theoretical calculations for a model in which every other close-packed, <110>-type row is removed, i.e., the "missing row" model. The analysis provides little agreement between measured profiles and the calculations for this particular model; e.g., the R factor as defined by Zannazzi and Jona is always greater than 0.6 for changes of both structural and nonstructural model parameters.

39105 Drift mobility correlation in a simple cubic lattice. Murch, G.E.; Thorn, R.J. (Argonne National Lab., IL). *J. Phys. Chem. Solids;* **39**: 1301-1305(1978).

A Monte Carlo method is described for the calculation of the drift mobility of interacting ions on a simple cubic lattice in an electric field. This formalism provides a useful operational model for electromigration in interstitial solid solutions. The results, which show a correlation in the drift of the ions, can be interpreted either in terms of a deviation from the Nernst—Einstein relation in the sense of vacancy wind effects or as an intrinsic correlation effect in the diffusion coefficient of the charge carriers. It is also shown that the usual tracer correlation factor can be calculated upon subtracting the square of the average drifts from the average squared displacements.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 38625, 38631, 38697, 38719, 38805, 38806, 38812, 38822, 39103, 39161, 39269

39106 (CONF-790343—1) **Selected advances in materials research.** Cunningham, J.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From American Society for Metals advisory technical awareness council meeting; Cleveland, OH, USA (27 Mar 1979).

Several findings emanating from materials research that should have a beneficial impact on technological advancement in the future are described. The report deals with the GRAPHNOL, a new class of high-temperature brazing alloy for joining refractory components, gel-sphere-pac process for manufacture of nuclear fuel, and noble-metal fuel cladding for service in radioisotope thermoelectric generators designed to provide auxiliary power aboard spacecraft for planetary exploration.

39107 (INIS-mf—4506, pp v) **Influence of the stress state on Ksub(Ic).** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

To get a first impression of the influence of stress states of higher multi-axiality than plane strain on Ksub(c) a specimen has been created, in which a bi-axial nominal stress state arises by uniaxial tension. This is attained by tension superimposed by transverse bending stress. The stress distribution without crack was analysed by photoelasticity as well as by finite element method. The results were identical. The stress distribution in the fracture (crack) plane was somewhat inhomogeneous, of course. But the ratio of the stress parallel to the tension axis to that perpendicular to it was max. 1:0.3 with a mean value 1:0.15. Specimens of this type were machined from a rolled sheet of the steel 22 NiMoCr 37, with specimen thickness of about 50 mm. For comparison single-edge notched specimens of the same cross section were prepared from the same material. Fatigue cracks were made following ASTM Recommendations. The fracture mechanics tests were carried out at a temperature of -100°C. Although valid Ksub(Ic)-values following the rigorous intention of the linear elastic fracture mechanics (ASTM Recommendations) were not obtained, the differences between the results of the two types of specimens and stress states were significant. The Ksub(Q)-values of the bi-axial stressed specimen were about 25% lower than that of the single-edge notched specimen. The deviation of the load-displacement trace from the linear elastic behavior was greater for the single-edge notched specimens than for the bi-axial stressed specimens. The consequences of these results for the assessment of flaws in pressure vessels are evident considering that bi-axial nominal stress states occur in pressure vessels.

39108 (INIS-mf—4506, pp v) **Influence of transverse shear on plasticity around an axial crack in a cylindrical shell.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A plasticity model for a semi-elliptical axial surface crack is developed. It generalizes Dugdale's assumption of a concentrated yield zone in the plane of the crack, and a continuous stress distribution is assumed in the yield zone. The inherent difficulties arising from the use of shell theory to model a three-dimensional problem can be overcome when the crack is sufficiently deep and the material is so ductile that full yield of the section around the crack develops before failure. In that case the calculations confirm the initial assumption of separation of the crack surfaces and the sides of the yield zone. The model is used to analyse published test data on surface cracked pressurized pipes. The analysis consists in COD evaluation and estimate of failure as consequence of plastic instability. COD values are found at the crack front and bottom. The plastic instability treated here is due to occurence of large plastic strains around the crack causing the section to be contracted. Thus the effective crack size is somewhat larger than the initial size. For sufficiently high loads this mechanism may lead to instability. A method is proposed which deals with the problem by simultaneous analysis of a number of cracks with increasing depth. The method avoids iterations and enables for any load and crack length the calculation of the smallest crack depth, which wo.

39109 (INIS-mf—4506, pp v) **Improved stress-intensity factors for semi-elliptical surface cracks in finite-thickness plates.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this paper is to present accurate stress-intensity factors for shallow and deep semi-elliptical surface cracks in plates using a three-dimensional finite-element analysis. To verify the accuracy of the solutions, convergence was studied by varying the degrees of freedom in the finite-element models. These models were composed of singular elements around the crack front and isoparametric elements elsewhere. Mode I elastic stress-intensity factors were calculated by using a nodal force method. To establish the validity of the present method, two problems: (1) a circular (penny-shaped) crack and (2) an elliptical crack buried in a very large body subjected to tension were analyzed. The results obtained from the present method for these crack shapes were within 1 percent of the exact solutions obtained from the literature. The present method was used to analyze a semi-elliptical surface crack in a plate subjected to tension. The configuration had a crack depth-to-surface crack half length ratio of 0.2 and crack depth-to-plate thickness ratio of 0.8. Convergence of the stress-intensity factors was studied using five different finite-element models. The degrees of freedom associated with these models ranged from 1500 to 6900. The 6900 degrees of freedom model was more than twice that used by Kathiresan. Rapid convergence of the solution was demonstrated because the two finest models gave stress-intensity factors within 1 percent of each other.

39110 (INIS-mf—4506, pp v) **Some comments about the J_1 integral criterion in post yield fracture mechanics.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Several criteria have been proposed for Post Yield Fracture Mechanics. One of the most interesting ones is the J_1 integral. When the behavior of material is elastic (even non-linear) it can be shown that J_1 is not path dependent (for a straight crack without thermal stresses). For this reason, it may be considered that J_1 characterizes the crack tip singularity. Extension is easy to deformation-type elastic plastic material, but there is no proof of path independence for flow-type plastic material (incremental plasticity or creep). Experimental results are often given as a proof of J_1 criterion validity. But there is no experimental value of a contour integral and assumptions are made in the use of experimental results. The main assumption implies that the received mechanical work (strain energy) is not dependent of the loading history (is only dependent of mechanical state). In order to have an empirical idea of the J_1 path independence, it is possible to make computations with finite elements method. Some results are given and it seems that no noticeable path dependence is seen with simple shapes and radial (proportional) loading. A few cases with complex way of loading are also studied.

39111 (INIS-mf—4506, pp v) **Application of the J-integral concept to cracks emanating from a hole.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Fracture of flawed heavy section steel structures such as LWR pressure vessels is generally preceded by considerable plastic deformation ahead of the crack tip, thus requiring application of elastic plastic fracture mechanics (EPFM) concepts. This holds in particular for areas with high nominal stress and strain where yielding may occur even in the absence of flaws, e.g. nozzle corner regions. One such EPFM concept is the J-integral concept, currently arousing considerable interest mainly because of its potential to yield a fracture toughness characterizing parameter from small specimen tests. However, studies aimed at verification of the applicability of this concept to actual structures are very scarce. The present study is aimed at such a verification by a combined theoretical and experimental approach for the case of through-cracks emanating from a hole in a plate.

39112 (INIS-mf—4506, pp v) **Outer and inner surface flaws in thick-walled pressure vessels.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the present paper, an embedded singularity, fully three-dimensional hybrid-displacement finite element model, as applied to linear fracture analysis, the theoretical development of which is given in Atluri et al. (paper L 7/3, 3rd SMiRT), is employed to

directly compute SIF's in the above class of problems. The developed hybrid-displacement model is based on a modified variational principle of total potential energy with three independently assumed field variables, which are: (a) an arbitrary displacement field u in the interior of each element in which, in the case of elements near the crack front, the asymptotically correct $\sqrt{r}$ type analytical solution is embedded; (b) an inherently compatible interelement-boundary displacement field: ν; and (c) a boundary traction field (Lagrange Multiplier) which is used to enforce the boundary displacement compatibility condition, $u=\nu$ at the interelement boundary. In the case of elements near the crack front, the asymptotically correct $1/\sqrt{r}$ type analytical solution is embedded in the boundary traction field. The developed procedure has been checked for its convergence properties by solving problems such as embedded penny shaped, or elliptical cracks in infinite domains, for which analytical solutions are available. Through this study, an optimum size of the elements near the crack front, as compared to the 'characteristic length' of the crack, is also derived. The procedure was then applied to study the present class .

39113 (INIS-mf—4506, pp v) **Finite element elastic-plastic analysis of initiation and stable crack growth in three-point bending.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The influence of the size of the elements along the crack path and of the initial state of the material (coalescence limit) was investigated. The influence of temperature in the ductile regime is included through the yield stress. The influence of hardening was also studied. During all the processes, the evolutions of load, displacement, crack advance, local strains and stresses, crack opening angle, J integral, separation work, plastic zones, K'sub(I) in the case of small-scale yielding, hence the corresponding R-curves were displayed. This permits some comparison with the previously mentioned criteria. The second stage of this study is planned as follows: experimental results will be available in the first months of 1977 for two steels, these experiments being accompanied by metallurgical studies of the corresponding microscopic mechanisms of ductile fracture. The parameters of our model will be adjusted on one set of experiments, with guidance of the metallurgical study. And then large variations of the conditions of the tests will be made as explained before, where calculations and corresponding experiments will be compared. The adequacy of the other criteria will be also teste.

39114 (INIS-mf—4506, pp v) **Method of line applied to 3-D crack problems including plasticity effect.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Distribution of stress and displacement in structures containing crack-like flaws exhibit three-dimensional nature as well as crack tip stress concentration. Among all the approximate methods in solving these types of problems, the method of line is probably the least known. The Method of Line (MOL) is a method that tends to keep the advantages and discards the disadvantages of both the analytical and grid methods of integration. The idea is to substitute the derivatives with respect to some, but not all, independent variables by finite differences. This approach replaces a given differential equation by a system of differential equations with lower number of independent variables. The problem of a thick-walled cylindrical hollow tube under internal or external radial pressure is studied in detail. The Navier-Cauchy equations, the governing equations for elastic behavior, are reduced to ordinary differential equations along radial lines and axial lines. These equations are solved by using a method similar to that of Gyekenyesi and Mendelson. Distributions of stresses and displacements for a finite length cylinder with axially varying radial loading are determined and presented in graphs. Results agree with the limiting cases of plane stress and plane strain as given by analytic solution in elasticity.

39115 (INIS-mf—4506, pp v) **Fracture mechanics practice for crack arrest.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes part of an extensive program at Battelle-Colombus concerned with measuring propagating crack toughness, Ksub(D) and defining the conditions under which a rapidly moving crack will arrest. Earlier publications have discussed the Ksub(D) data that have been generated and the testing procedures, including specimen size requirements. Here we concentrate on describing a method for determining the relation between Ksub(D) and crack velocity which bypasses the need for direct velocity measurements. As a result the test procedures are considerably simplified. The test method involves wedge-loading of duplex double cantilever beam specimens containing a blunt starter notch. Particular care is taken to approach fixed-grip conditions as closely as possible. As a result it is possible to initiate a rapidly moving crack and to arrest it. The results are analyzed with the aid of a finite difference procedure. A key result of the analysis, which has been confirmed experimentally, is that the crack length at arrest under fixed-grip loading is a single-valued function of the crack-velocity/bar-wave-speed ratio for fixed specimen dimensions. Of equal importance the ratio Ksub(D)/Ksub(Q)(Ksub(Q)=stress intensity at crack initiation) depends only on crack velocity, again for fixed specimen dimensions. Combining these two results, it is seen that the two desired quantities (Ksub(D) and velocity) can be found if Ksub(Q) and crack length at arrest are measured. The use of duplex specimens to facilitate rapid crack initiation complicates, but does not invalidate, the procedure. The paper describes how these procedures have been verified in tests on three heats of A533B pressure vessel steel in the temperature range (NDT -66°C) to (NDT +34°C).

39116 (INIS-mf—4506, pp v) **Interpretaion of the instrumented Charpy test.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A transient dynamic finite element computer code was developed specifically for crack propagation studies. This paper describes the application of the code to the analysis of the modified Charpy tests. There were two objectives; the first was to obtain a greater understanding of the mechanics of the Charpy test and the second was to explore the possibility of obtaining a fundamental material property from the test. The output from the code includes the time-dependent displacement, strain and stress fields, the variation with time of the force on the striker nose, the crack initiation time and the crack extension/time relationship. The paper includes representative experimental and computed results for two materials, bisphenol-A polycarbonate and a mild steel tested at low temperature. The computer predictions were 'tuned' to the experimental results by adjustment of parameters representing (i) the initial bluntness of the crack, (ii) the dynamic initiation toughness (iii) the velocity-dependent dynamic toughness appropriate to a running crack (Ksu(D)) and (iv) the striker/specimen contact stiffness. The resulting agreement between the computer predictions and the experimental measurements is most encouraging, giving confidence in the ability of the model to predict the behavior of the Charpy specimen in greater detail than was possible hitherto. For example, in the case of a comparatively brittle specimen, the present model predicts oscillations of the central bending moment which the simpler model does not predict.

39117 (INIS-mf—4506, pp v) **Stress intensity factors of corner cracks in two nozzle-cylinder intersections.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A recent paper presented the stress-intensity-magnification factors of a quarter-elliptical surface crack in a quarter-infinite solid and a circular crack approaching a reentry corner in a three-quarter infinite solid. These stress-intensity-magnification factors were used together with a curvature-correction factor to estimate the stress-intensity factor of a corner crack at a nozzle-cylinder intersection. Through appropriate superposition of the above stress-intensity-magnification factors, stress-intensity factors for hypothetical corner cracks at a nozzle-cylinder intersection subjected to internal pressure and transient thermal-stress loadings can be obtained. A description of a computer code based on this procedure as well as its applications in analyzing two corner-crack problems at a nozzle-cylinder intersection are discussed.

39118 (INIS-mf—4506, pp v) **Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Analysis of the behavior of cracked structures built with ductile materials, such as standard steels currently used in pressure vessels, presents notable difficulties. This paper describes and gives the results of an experimental work dealing with these problems. The test program can be divided in three principal parts: (a) Influence of CT specimen size on toughness measurements; (b) Influence of large strain-hardening (before testing) on limit loading of center-cracked specimen; (c) Scale effect on the behavior of spherical vessels weakened by through-wall notches, with a large range of ratio 2a/D. Measurements of toughness with CT specimen were made on three different carbon steels, of which yield strength ranged from 40 to 127 Ksi. The effect of an important loss of ductility has been searched by testing up to failure some center-cracked specimens. Before machining of notches, large amounts of plastic elongation (20%, 50% and 80% of strain at ultimate strength) were imposed by appropriate tension loading of the rough specimens. Tests on spherical vessels were performed on ten spheres of three

different sizes. Ratio 2a/D ranged from 0.05 to 0.345, and toughness measurements were made by using small size CT specimens cut off from the vessels walls, after tests. All these experimental tests results indicate that similitude rules are applicable to small and medium vessels, and the given results allow to get curves showing the relationships between both initiation or unstable propagation of crack, and geometrical parameters dealing with the crack length. Results of the three large spheres differ chiefly by the different modes of failure observed.

39119 (INIS-mf—4506, pp v) **Advances in fracture mechanics analyses of primary system performance under operating and accident conditions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Safety research sponsored by the Nuclear Regulatory Commission, Division of Reactor Safety Research, has resulted in notable advances in several areas of importance in the safety evaluation of reactor primary systems under normal operations and accident situations. First, the methods of Linear Elastic Fracture Mechanics and of Elastic Fracture Mechanics have been validated for prediction of pressure vessel performance by the Intermediate Vessel Test program results at the Oak Ridge National Laboratory. This ability to confidently predict vessel performance under realistic service conditions has permitted development of the computer program OCTA-VIA which computes failure curves for a range of flaw sizes in terms of pressure and temperature for specified pressure vessel material at specific neutron fluence levels. The code then considers the probability of occurrence of flaw sizes and magnitude of pressure and determines the probability of failure for both individual flaw and sizes and for the full spectrum. A second advance in fracture mechanics technology has been made in thermal shock analysis. This advance has been verified by the confirmatory results of testing small tick-walled cylinders under thermal shock conditions in the Heavy Section Steel Technology program, and of warm prestressing tests at the U.S. Naval Research Laboratory. Thirdly, the technology of crack arrest has reached a level wherein standardization of test specimens and tesing methods is now possible and, indeed, is underway.

39120 (INIS-mf—4506, pp v) **Crack initiation and growth in welds at 1100°F (593°C).** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purposes of the rupture tests performed at 1100°F (593°C) were to determine the strain for crack initiation and to study the factors which influence the crack growth rate. The gradient of plane strain in the weldment causes the axial strain to be a minimum at the heads and to increase toward mid-length. This enables a study of the strain for crack initiation along the specimen length as the creep strains increase with time. The local strains along the length and in the various parts of the weldment were determined during the tests by measurements from photographs of a grid on the surface of the specimen. It is postulated that the cracks initiate from an exhausion of local ductility which is a function of the strain rate and stress state. In these tests it was found that intergranular cracks initiated along the HAZ of the weld at regular spacing when the local axial strain exceeded about 4% for the creep rate of about $4x10^{-5}$ per hour. The time at crack initiation is about equal to that for rupture of the base metal at the same average stress level. The general transverse direction of the crack growth is perpendicular to the direction of the maximum principal stress. The crack growth rate at each HAZ was proportional to the net section creep rate which also controls the crack-opening-displacement rates. The transverse crack growth rate is about six times faster in the base metal than that across the weld. Accelerated crack growth rate occurs when the cracks on each side of the weld grow sufficiently to interact.

39121 (INIS-mf—4506, pp v) **Analysis of cracks by means of FEM.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

FEM techniques are presented to define stress intensity factors for arbitrary 2D and 3D thermo-elastic crack problems. For 3D problems energy techniques are compared to the classical and a more refined displacement substitution method using 1/4 point singularity elements. For 2D problems an efficient implementation of crack closure work is developed introducing the Lagrangian multiplier technique. Physically the Lagrangian multipliers represent the crack closure forces. However, in the displacement method they are dealt with as unknows added to the vector of unknown DOF.

39122 (INIS-mf—4506, pp v) **Pressure vessel fracture safety investigations using as criterion the onset of crack propagation.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

For the nuclear pressure vessel frangible behavior can be normally excluded. The critical material characteristic at fracture, Ksub(IC), is with linear elastic fracture behavior of steels near to the onset of stable crack growth. With elastoplastic material behavior the onset point of the stable crack growth and the actual fracture may be well apart. The 5% secant method is here of little use. The onset point can be down to 60% of the Psub(max). As a lower bound criterion the onset of stable crack growth is proposed. This point is detected on RPV steel by acoustic emission method and confirmed with heat tinting tests. From load at initiation of propagation Psub(i) the value of Ksub(Ii) can be derived. Similarly deltasub(i) can be measured. For the purpose of measuring deltasub(i) clip-in gauges were used according to the 'Swiss guidelines for the measurement of COD'. From the load/clip gauge displacement record, the load and clip gauge displacement at the onset of stable crack growth can be determined. These values are then used to calculate Ksub(Q), Ksub(Ii), deltasub(i) and Ksub(ICD). It is the purpose of this paper to show experimentally that in the elasto-plastic range a similarity exists between the critical crack sizes as determined by Ksub(Ii), COD, J and equivalent energy methods.

39123 (INIS-mf—4506, pp v) **Stable crack growth under sustained load.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Stable crack growth will be of great importance at the pressure test, because of the high stress level during the test. According to the extent of the crack growth a premature failure of the structure is possible. Because of the enlargement of the cracks the fatigue life time of the structural components will be reduced. The damage of structural components, which operate at high temperatures, occurs rapidly in regions of high stress levels where the supportable strain values are exceeded first. The increase of cracks by stable crack growth causes high creep strain values at the crack tip. It shall be shortly mentioned that stable crack growth influences stress corrosion cracking, too. Test materials selected for the investigation are the reactor pressure vessel steel 22 NiMoCr 37 (similar to A533 Grade B class I) and a mild steel St 37. The tests are carried out with CT-Specimens 12,5, 20, 50 and 100 mm thick. Besides the influence of the thickness, that means the stress state, the influence of the initial crack length and the environment (air and water) are investigated, too. In order to measure the influence of different structures caused by welding heat treatment in the heat affected zone, the mild steel St 37 was investigated in two different states of heat treatment. The results were examined by application of the linear fracture mechanics and the J-Integral criterion to characterize the beginning of stable crack growth.

39124 (INIS-mf—4506, pp v) **Geometric influences upon stress intensity distributions along reactor vessel nozzle cracks.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes the results obtained by applying a computer assisted photoelastic technique for estimating Mode I stress intensity factor (SIF) distributions for mathematically intractable three-dimensional problems to the reactor vessel nozzle corner crack problem. Two significantly different test programs were employed and results were compared with the literature. Frozen stress photoelastic experiments were conducted on two classes of nozzle corner cracks: (i) Researchers at the Delft University Laboratory for Nuclear Engineering have developed a nozzle-flat plate geometry which is loaded in remote uniaxial tension normal to the flaw. The transverse tension can then be included analytically. Their results indicate that such a model accurately predicts fatigue crack growth for the corresponding cracked nozzle in a pressure vessel for thin walled vessels. The test geometry identified as No.4 in the Delft work was studied experimentally in the present work. (ii) Researchers at Oak Ridge National Laboratory developed a technique for predicting SIF's in cracked nozzles in thick walled pressure vessels from residual static strength tests on fatigue cracked plastic models of nozzle-cylinder intersections. The test geometry identified as the 'small thick walled vessel' in the Oak Ridge program was studied experimentally in the present work.

39125 (INIS-mf—4506, pp v) **Cracked element approach for the computation of stress intensity factors.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the work is to evaluate the influence of different matching conditions between a cracked element and the surrounding regular elements upon the stress intensity factors for plane problems. The influence of size and type of the elements has

been studied as well. The cracked element is a polygon with a linear crack. The coordinate system has its origin at the crack tip and the negative x_1-axis along the crack. The work is based upon the complex variable formulations of Muskhelishvili for homogeneous isotropic material. The stresses and displacements are written as series expansions of the complex variable in the x_1-x_2 plane, taking into account the condition of traction free crack surfaces. The stress intensity factors Ksub(I) and Ksub(II) correponding to the crack edge opening resp. sliding mode can be found directly from the coefficient of the first term of one of the stress functions. The above representation of the crack tip element satisfies the conditions of internal equilibrium (neglecting body forces), compatibility and Hooke's law. The strain energy of the element is found by numerical integration (Gauses quadrature) along the element edges. By varying the element sizes and element types it has been found that a very limited number of surrounding regular elements with a quadratic displacement field is sufficient to compute very accurate stress intensity factors.

39126 (INIS-mf—4506, pp v) **Methodology for plastic fracture. A progress report.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The initiation and growth of flaws in pressure vessels under overload conditions is distinguished by a number of unique features, such as large scale yielding, three-dimensional structural and flaw configurations, and failure instabilities that may be controlled by either toughness or plastic flow. In order to develop a broadly applicable methodology of plastic fracture, these features require the following analytical and experimental studies: development of criteria for crack initiation and growth under large scale yielding; the use of the finite element method to describe elastic-plastic behavior of both the structure and the crack tip region; and extensive experimental studies on laboratory scale and large scale specimens, which attempt to reproduce the pertinent plastic flow and crack growth phenomena. A variety of candidate criteria for crack initiation and growth are examined. For the case of crack initiation, these criteria include the J-integral, crack opening displacement, and strain amplitude. In the case of crack growth, the criteria examined include in addition the strain amplitude at the crack tip, work done in a crack tip process zone, and a generalized energy release-rate approach. Each test specimen configuration is analyzed through the finite element method in order to predict its experimental behavior. Specimens include the compact tension specimen and center cracked panels. The basic materials used in the program are a single heat of reactor grade A533 Grade B Class 1 steel, purchased in the form of a plate of size 4.5 m (178 in.) square and 0.2 m (8 in.) thick, and two alloys with yield strength-to-roughness ratios about five times .

39127 (INIS-mf—4506, pp v) **Enhancement of the quality of the reactor pressure vessel used in light water power plants by advanced material fabrication and testing technologies.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The fracture safe assessment of nuclear pressure vessels (RPV) is based upon: (i) an adequate stress analysis, (ii) reliable material characteristics, (iii) acceptable defect sizes. There may arise problems which are related to the inhomogeneity, low toughness and crack phenomena sometimes observed in the base material and heat affected zone (HAZ). Due to this it is difficult and in some respects even impossible to measure the decisive values of (fracture-) toughness and defects. Apart from the significance of those facts for existing RPVs, all efforts were directed to provide a steel which should be non-susceptible to embrittlement and/or cracking in the HAZ, and simultaneously yielding in a higher upper shelf toughness of base and HAZ material. These objections were pursued in cooperation with manufacturers, vendors and inspection authorities by the following activities: (i) detailed investigations to obtain information on: occurence and size of inhomogeneities and defects, especially stress relief cracking (SRC), toughness properties adjacent to defects; (ii) improvement of chemical composition, steel making processes, welding procedures, optimum temperature cycle and level for stress relief heat-treatment.

39128 (SAND—79-0636C) **Nondestructive examination of deformed steel and nickel by positron annihilation.** Gauster, W.B.; Wampler, W.R.; Jones, W.B.; Van den Avyle, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790437—1). Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Positron Annihilation (PA) Doppler broadening measurements were made on cold-rolled and fatigue cycled 316 stainless steel. PA measurements were made after isochronal annealing steps following deformation at 294 K of both 316 SS and high purity nickel. To understand the response of PA to microstructural changes, specimens were examined by transmission electron microscopy. It is concluded that in nickel both vacancies and dislocations produced by cold working can act as positron traps. In 316 SS, the PA response is principally due to vacancies, and only small effects can be attributed to trapping at dislocations.

39129 **Solid metal embrittlement of Ti—6Al—6V—2Sn by cadmium, silver and gold.** Stoltz, R.E.; Stulen, R.H. (Sandia Laboratories, Livermore, CA). Contract AT(29-0)11789. *Corrosion;* **35**: No. 4, 165-169(Apr 1979).

Solid metal embrittlement of Ti—6Al—6V—2Sn has been observed with Cd, Ag, and Au. A threshold temperature of 477 to 505 K exists for Ag and Au, below which no embrittlement was observed. Embrittlement by Cd at 421 K was confirmed. No embrittlement due to Cu or Ni was observed at temperatures as high as 560 K. Scanning Auger analysis of Ag and Cd embrittled samples indicated that (1) the fracture path is intergranular, (2) surface diffusion is the limiting transport mechanism, and (3) surface diffusion of Cd and Ag is over the titanium oxide. The fracture process is discussed in relation to liquid metal embrittlement.

39130 **Elastic energy of slit cracks in hexagonal crystals.** Yoo, M.H. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Scr. Metall.;* **13**: No. 2, 131-136(1979).

For twenty-four hexagonal crystals including sixteen hcp elemental metals, the ratios of the surface energies and the brittle fracture stresses between (0002) and [1100] were calculated and the results are given. Unless indicted otherwise, these results are based on the elastic constants at room temperature [6], and the numbers in parentheses for Mg alloys are in atomic percent. The listed values of σ/sub b//σ/sub p/ are the preferred direction perpendicular to the c vector axis, or parallel to the a vector axis. By far the smallest value of σ/sub b//σ/sub p/ is 0.03 for graphite, the next group for σ/sub b//σ/sub p/ < 1 contains Cd and Zn, and the rest belongs to σ/sub b//σ/sub p/ greater than or approx. = to 1. According to the calculated results based on anisotropic elasticity, the habit plane should be the basal plane for graphite, Zn, and Cd and the prism plane for Tl, and Zr, Ti, at elevated temperatures if brittle fracture by cleavage occurs. Isotropy or near isotropy is predicted for the rest including those of Wurtzite structure (BeO, ZnO, CdS) and ice crystals. Most of the experimental data available in the literature is consistent with the present prediction.

39131 **Measurement of residual stresses in claddings.** Hofer, G.; Bender, N. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). pp 9-96 of Residual stresses in welded construction and their effects. Vol. 1. Papers. Cambridge; Welding Institute (1978).

From Conference on residual stresses in welded construction and their effects; London, UK (15 Nov 1977).

The ring core method, a variation of the hole drilling method for the measurement of biaxial residual stresses, has been extended to measure stresses from depths of about 5 to 25mm. It is now possible to measure the stress profiles of clad material. Examples of measured stress profiles are shown and compared with those obtained with a sectioning technique.

39132 **Estimation of residual stresses in reactor pressure vessel steel specimens clad by stainless steel strip electrodes.** Schimmoeller, H.A.; Ruge, J.L. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Schweisstechnik und Werkstofftechnologie). pp 51-258 of Residual stresses in welded construction and their effects. Vol. 1. Papers. Cambridge; Welding Institute (1978).

From Conference on residual stresses in welded construction and their effects; London, UK (15 Nov 1977).

The equations to determine a two-dimensional state of residual stress in flat laminated plates are well known from an earlier work by one of the authors. The derivation of these equations leads to a linear, inhomogeneous system of Volterra's integral equations of the second kind. To ascertain the unknown residual stresses from these equations it is necessary to cut down the thickness of the test plate layer by layer. This results in two-dimensional deformation reactions in the rest of the test plate, which can be measured, e.g. by a strain gauge rosette applied to the opposite side of the plate. The above-mentioned stress analysis has been transferred to 86mm thick reactor pressure vessel steel specimens (Type 22NiMoCr 37, DIN-No. 1.6751, similar to ASTM A508, Class 2) double-run clad by austenitic stainless steel strip electrodes (first layer 24/13 Cr-Ni steel, second layer 21/10 Cr-Ni steel). The overall dimensions of the clad specimens investigated amounted to 200 x 200 x (86+4.5+4.5)mm. At the surface of the austenitic cladding there is a two-dimensional tensile normal stress state of about 200N/mm^2 parallel, and about 300N/mm^2 transverse, to the welding direction. The maximum tensile stress was 8mm below the interface (fusion line, material transition) in the parent material. The stress distributions of the specimens investigated, determined on the basis of the above-mentioned combined experimental mathematical procedure, are presented graphically for the as-welded (as-delivered) and annealed (600°C/12hr) conditions.

39133 Mechanics of penetration and perforation. Wilkins, M.L. (Lawrence Livermore Lab., CA). *Int. J. Eng. Sci.;* **16**: 793-807(1978).

The various deformation mechanisms that occur when a projectile strikes a target at normal incidence are analyzed with the aid of a computer simulation program. An objective of the analysis is to identify the important material parameters in targets and projectiles that influence perforation. 15 figures, 1 table.

39134 Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978). 362p. (AGARD-CP—243; CONF-7804115—). NTIS.

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

Separate abstracts have been prepared for items within the scope of the energy data base. (FS)

39135 Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80. Kortovich, C.S.; Sheinker, A.A. (TRW Inc., Cleveland, OH). pp 1.1-1.23 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

A strainrange partitioning analysis was conducted on ultra-high vacuum, strain-controlled, low cycle, fatigue behavior of uncoated and aluminide coated Rene' 80 nickel-base superalloy at 1000°C (1832°F) and 871°C (1600°F). The results indicated little effect of coating or temperature on the fatigue resistance. There was, however, a significant effect on fatigue life when creep was introduced into the strain cycles. The effect of this creep component was analyzed in terms of the method of strainrange partitioning. The longest lives were obtained with Δ ϵ/sub pp/ type cycling, while the Δ ϵ/sub cc/ cycle caused a reduction of fatigue life of about 1/2 order of magnitude with respect to the Δ ϵ/sub pp/ life. The Δ ϵ/sub cp/ type cycle caused a life reduction of slightly less than 1 order of magnitude with respect to the Δ ϵ/sub pp/ life, while the Δ ϵ/sub pc/ type cycle provided a fatigue life approximately 1 order of magnitude below that of the Δ ϵ/sub pp/ life. Metallographic evaluation indicated that microstructural damage varied with cycle type and test temperature. Specimens tested with the Δ ϵ/sub pp/ type deformation exhibited a trasgranular fracture mode. Specimens tested with the Δ ϵ/sub pc/ type deformation exhibited an intergranular fracture mode with extensive grain boundary sliding resulting in steps or grain extrusions, particularly At 1000°C (1832°F). Specimens tested with the Δ ϵ/sub cp/ type deformation exhibited an intergranular fracture mode, while the Δ ϵ/sub cc/ specimens exhibited different fracture modes depending on test temperature. At 1000°C (1832°F), the fracture mode was intergranular, while at 871°C (1600°F), the fracture mode was transgranular.

39136 Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100. Halford, G.R.; Nachtigall, A.J. (National Aeronautics and Space Administration, Cleveland, OH). pp 2.1-2.14 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

A study assessed the ability of the method of strainrange partitioning (SRP) to both correlate and predict high-temperature, low-cycle fatigue lives of nickel-base superalloys for gas turbine applications. Baseline data from strain-controlled, low-cycle fatigue tests are expressed in terms of the PP, PC, CP, and CC partitioned inelastic strainrange versus life relationships for coated and uncoated Rene' 80 at 1000°C, Gatorized (creep-formed) IN 100 at 760°C, and cast IN 100 at 925°C. SRP is shown to correlate the cyclic lives of the baseline tests to within factors of nearly two. The partitioned strainrange versus life relationships for uncoated Rene' 80 and cast IN 100 have also been determined from the Ductility Normalized-Strainrange Partitioning (DN-SRP) equations. These were used to predict the cyclic lives of the baseline tests. Predicted and observed cyclic lives agreed to within factors of nearly three. The life predictability of the method is also verified for cast IN 100 by applying the baseline results to the cyclic life prediction of a series of complex strain-cycling tests with multiple hold periods at constant strain. Predictions were within factors of two in cyclic life. It is concluded that the method of SRP can correlate and predict the cyclic lives of laboratory specimens of the nickel-base superalloys evaluated in this program.

39137 Low cycle fatigue behavior of IN-100: strainrange partitioning method. VanWanderham, M.C.; Wallace, R.M.; Annis, C.G. Jr. (Pratt and Whitney Aircraft, West Palm Beach, FL). pp 3.1-3.17 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

The elevated temperature, low cycle fatigue behavior of the gas turbine disk alloy IN-100 is evaluated using the strainrange partitioning method. Strainrange partitioning, an advanced life prediction analysis procedure, assumes that any hysteresis loop can be represented by combinations of the four generic cycle definitions: PP, CP, PC, and CC. The first letter refers to the material response in tension, either Plastic (time dependent) or Creep (time dependent), and the second letter refers to material response in compression. There is considerable interest in the gas turbine industry in understanding and accurately predicting the effects of various types of possible dwells, e.g., pure creep or stress relaxation, on the LCF life of critical rotating components. In this investigation, PP and CP curves were developed for GATORIZED IN-100 at 649°C, man strain equal to half maximum strain. Tensile Hold Strain Cycle (THSC) and Tensile Creep Stress Dwell (TCSD) tests were used to determine CP-type response. When cycled at the same inelastic strainrange (measured at half-life) THSC specimens survived approximately twice as long as TCSD tests. However, when strainrange partitioned, there is no significant difference between THSC and TCSD results and a single CP relation can be used to predict accurately the life of either type of tensile dwell test.

39138 Strainrange partitioning of Mar 002 over the temperature range 750°C—1040°C. Antunes, V.T.A.; Hancock, P. (Cranfield Inst. of Technology, Bedford, England). pp 5.1-5.9 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

The fatigue behavior of a cast nickel base superalloy Mar M002 has been studied in the temperature range 750° to 1040°C by the method of Strainrange Partitioning, (SRP). The four basic strainrange vs life relationships Nij - Δ ϵij (i = P or C; j = P or C) were determined at 850° and 1040°C. A marked temperature sensitivity was observed and it was not possible to predict lu40° lives from 850 data. However, satisfactory life prediction could be made by the SRP method over limited temperature ranges. Prediction within the range 750 to 850°C, or within the range 950 to 1040°C proved to be satisfactory, employing a unique set of Nij - Δ ϵij strainrange vs life relationships for each temperature range.

39139 Low cycle fatigue behavior of Nimonic 90 at elevated temperature. Harrison, G.F.; Weaver, M.J. (National Gas Turbine Establishment, Farnborough, England). pp 6.1-6.19 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

High temperature strain controlled fatigue data for the wrought nickel base alloy Nimonic 90 are presented together with their interpretation based on the concept of strain range partitioning. When this approach was used to predict data at 650 and 900°C using those generated at 810°C, the lives at 650°C were accurate to within a factor of two whereas at 900°C, actual test results were much less than the predicted values. Also discussed is the difficulty encountered when using the partitioning approach to predict low frequency test results, as answers are very sensitive to the ways in which cycles are partitioned into their creep and plastic components. Finally, the data are examined in terms of stress as opposed to strain and predictions using a stress/static-creep data approach are compared to those obtained using strain range partitioning.

39140 Strainrange partitioning applied to Ti—6Al—V. Nowack, H.; Vreke, J. (German Aerospace Research Establishment, Cologne, Germany). pp 13.1-13.12 of Characterization of low cycle high temperature fatigue by the strainrange partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

The SRP-method is applied at Ti—6Al—4V in a temperature range where significant creep occurs (450°C). From the tests with HRSC, TCCR and BCCR cycle types it has been determined that the TCCR and CCCR cycles lead to alterations in the mean stress level and that the CCCR type reduces the crack initiation life significantly. The predictions of the SRP method for complex cycles coincided well with the corresponding test results, when the test durations for the HRSC, TCCR, CCCR and for the complex cycles remained of the same order of magnitude. When the testing time with complex cycles significantly increased a deviation was observed. Some possible explanations for the observed behavior are given.

39141 Strain range partitioning in cyclic creep of a 1Cr—Mo—V steel. Ellison, E.G. (Univ. of Bristol, England). pp 14.1-14.19 of Characterization of low cycle high temperature fatigue by the strain-range partitioning method. Neuilly-sur-Seine, France; Advisory Group for Aerospace Research and Development (1978).

From 46. meeting of the AGARD structures and materials panel; Aalborg, Denmark (11 Apr 1978).

A 1 Cr—Mo—V ferritic steel has been subjected to fatigue/creep conditions at 565°C. Most of the data obtained were from strain controlled tests with and without hold periods. Some load controlled results were also obtained. The strain range partitioning (SRP) method for predicting lives at long hold periods, and under complex load cycles, was applied. With this material, good correlation of data using the Ductility Normalized SRP was obtained, although even better correlation resulted when the SRP method was modified to take account of the length of the hold period.

39142 Material data for high temperature design. Goodman, A.M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.); Orr, J. (British Steel Corp., Sheffield). pp 45-55 of Recent developments in high temperature design methods. London; Mechanical Engineering Publications for IMechE (1977).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

Modern methods for the design of steadily loaded structures for operation within the creep range allow more efficient design and provide more reliable estimates of future behaviour of components in creep. The materials data requirements are identified and suitable forms of presentation discussed. It is found that information on ductility and the creep strain behaviour now have a redefined significance. It is then shown that the required creep strain data can be made available using existing test points and effective correlation procedures.

39143 High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat. Niessen, H.F.; Kugeler, K.; Kugeler, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). pp 204-211 of Advanced high temperature materials: technological and industrial aspects. Kroeckel, H. (ed.). Paris, France; Masson (1977).

From 1. colloquium on advanced high temperature materials; Petten, Netherlands (29 Jan 1976).

Steam reforming is used to convert light hydrocarbons with steam to hydrogen or a mixture of hydrogen and carbon monoxide. This process requires heat at temperature in the range of 700-800 deg C which can be supplied by a high temperature reactor as nuclear process heat. Requirements for helium-heated reformer tube materials and a comparison to the conventional techniques are given. The maximum helium temperature of 950 deg C is sufficiently high and heating is more uniform. Stresses for the nuclear heated tubes are lower, it is not necessary to use high strength alloys but the relatively simple material HK40 and Incoloy 802. Hydrogen and tritium permeation are tolerable if oxide layers are formed. Corrosion is examined.

39144 Recent developments in high temperature design methods. London, England; Mechanical Engineering Publications for IMechE (1977). vp. (CONF-771255—).

From Conference on recent developments in high temperature design methods; London, UK (6 Dec 1977).

Separate abstracts were prepared for the individual papers presented at the meeting.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 38410, 39106, 39165

39145 (LA—7785-MS) Electronic configurations and energies in some thermodynamically correlated laves compounds. Campbell, G.M. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

The known electronic configurations of simple elements in Laves compounds are correlated with those of the more complex systems to determine their electronic configurations and gaseous state promotion energies.

39146 (LBL—8975, pp 52.-54.) Surface studies and catalysis . Jenkins, L.H. (Oak Ridge National Lab., TN). Feb 1979.

In Heterogeneous catalysis research meeting.

39147 (MLM—2600(TR)) Study on the diffusion of hydrogen into transition metal hydrides and their alloys. Malutchkov, O.T.; Lileeva, J.J.; Tchertkov, A.A. 23 Mar 1979. Translated from International Congress on Hydrogen in Metals, Paris, 1972, Paper. (CONF-720571—2(Trans)). 12p. Dep. NTIS, PC A02/MF A01.

From International congress on hydrogen in metals conference; Paris, France (29 May 1972).

The activation energy-alloy concentration dependences in hydrogen diffusion in the temperature range from -170 to +200°C have been determined from narrowing of proton magnetic resonance (PMR) spectra in the hydrides of alloy systems Ti—V, Ti—Nb, Ti—Mo. From the measurements of intensities of PMR spectra it has been found that hydrogen is redistributed between tetrahedral and octahedral sites of the fcc hydride lattice, depending on the concentration of the second component of the alloy and on temperature. The change in hydrogen diffusion activation energy as a function of the concentration of the second alloy component has been shown to be a linear combination of relative changes of lattice parameters and metallic ion effective charge.

39148 H^+ and D^+ sputtering of thin tantalum films in the energy range of 0.6 to 15 keV. Meyer, C.H. Jr.; Smith, J.N. Jr. (General Atomic Company, San Diego, California 92138). *J. Vac. Sci. Technol.;* **16**: No. 2, 248-250(Mar 1979).

The sputtering yield for H^+ and D^+ incident on Ta is measured using simultaneous and coincident Auger analysis and sputter etching of thin Ta films on Cu substrates. The maximum yield is found to be 4.5×10^{-3} atoms/ion for H^+ and 1×10^{-2} atoms/ion for D^+ at an energy of ~4 keV. Throughout the energy range studied, the data agree well with a semiempirical formula devised earlier for use in determining sputter yields for fusion reactor first wall materials [D. L. Smith, J. Nucl. Mater. 75, 20 (1978)].

39149 ELS vibrational study of carbon monoxide adsorbed on the Cu(110) surface. Wendelken, J.F.; Ulehla, M.V.K. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 441-444(Mar 1979).

The adsorbate site location for CO on Cu(110) has been investigated with electron energy loss vibrational spectroscopy. With low coverage at 80 K vibrational energies of 85 and 258 meV are observed. At high coverages and/or near the thermal desorption temperature of 170 K, only a single peak at 260 meV is observed. A simple spring model analysis of the vibrational energies indicates that a bridge position is occupied by CO in the first case and the on-top position in the second case although LEED results indicate that CO cannot be highly localized at any one site in the high coverage case.

39150 AES study of oxidation of surface and bulk sulfides of Ni. Windawi, H.; Katzer, J.R. (Center for Catalytic Science and Technology, Department of Chemical Engineering, University of Delaware, Newark, Delaware 19711). *J. Vac. Sci. Technol.;* **16**: No. 2, 497-502(Mar 1979).

The interaction of oxygen with sulfur-covered nickel and nickel sulfide surfaces was investigated by AES. For the adsorbed sulfur the interaction appears to proceed via an intermediate step prior to the removal of sulfur; a proposed mechanism of interaction is presented. This interaction is dependent on oxygen pressure. Under certain conditions three-layer oxide can form on a buried sulfur layer and this oxide is destabilized by the presence of sulfur. Oxidation of the nickel sulfide appears to be similar to that of the adsorbed-sulfur-on-nickel system with regard to oxide buildup. The effect of temperature on these processes is discussed.

39151 Theoretical studies of nickel clusters and chemisorption of hydrogen. Upton, T.H.; Goddard III, W.A.; Melius, C.F. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *J. Vac. Sci. Technol.;* **16**: No. 2, 531-536(Mar 1979).

First principles calculations of high- and low-symmetry clusters (up to Ni_{87}) are reported. Macroscopic properties [ionization potential (IP), electron affinity (EA), and bandwidth] are not sensitive to cluster symmetry and, except for EA, are converged to bulk values by Ni_{87}. Even for Ni_{87} the EA is over 2.5 eV smaller than the IP; the origin of this effect is discussed. The chemisorption of hydrogen is considered on the low-symmetry clusters, where it is found that threefold and fourfold sites are most favored with bond energies of ~3 eV for both types of sites. Geometries are not cluster sensitive with R (NiH) values of 1.57, 1.62, and 1.78 A for twofold, threefold, and fourfold sites, respectively. Vibrational frequencies for these sites are 1420, 1212, and 592 cm^{-1}, respectively.

39152 AES study of the adsorption of O_2, CO, CO_2, and H_2O on indium. Rossnagel, S.M.; Dylla, H.F.; Cohen, S.A. (Plasma Physics laboratory, Princeton University, Princeton, New Jersey 08540). *J. Vac. Sci. Technol.;* **16**: No. 2, 558-561(Mar 1979).

The adsorption of various oxygen-containing gases on clean polycrystalline In has been studied. For the In—O_2 system, the relationship between N (E) areas and dN (E)/dE peak heights for In MNN Auger transition was found to be linear. At saturation, an oxygen/indium ratio of 3/2 was measured, consistent with the formation of the stable oxide In_2O_3. Low-coverage sticking coefficients were found to be ~0.014 for O_2, ~0.004 for H_2O, $\sim 2 \times 10^{-5}$ for CO, and $\sim 5 \times 10^{-6}$ for CO_2. In each case, chemical shifts and peaks distortions in the N (E) and dN (E)/dE spectra have been

measured for the gas-saturated In, the largest being ~3 eV for the MNN transition of O_2-saturated surface.

39153 High-resolution LMM Auger spectra from argon implanted in Be and Si. Zehner, D.M.; Madden, H.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 562-565(Mar 1979).

The L/sub 2,3/M/sub 2,3/M/sub 2,3/ and L/sub 2,3/M_1M/sub 2,3/ Auger electron spectra from argon implanted by 1-keV ion bombardment in Be and Si crystals, have been obtained using a double-pass CMA operated in both the nonretard and retard modes. Background subtraction and loss-deconvolution were subsequently applied to obtain the final results. The argon-in-Be spectrum consists of a series of narrow peaks (FWHM less than 2 eV) which are sharper than those previously reported for the L/sub 2,3/M/sub 2,3/M/sub 2,3/ spectrum from solid argon. Associating the major peak in our spectrum with the L_3M/sub 2,3/M/sub 2,3/($^1D_2$) peak in the gas-phase spectrum leads to an identification in terms of energy separations of our peak structure with the principal peaks of the gas-phase spectrum to within 0.5 eV. We conclude that the transitions responsible for the Auger spectrum can be characterized as quasiatomic, although the multitude of gas-phase satellite peaks is not seen in our results. Peaks in the argon-in-Si spectrum are slightly broader than those in the argon-in-Be spectrum. As a result of screening by the conduction electrons in the host material, our argon Auger emission energies are higher than those in the gas-phase spectrum.

39154 Oxygen chemisorption on Bi (0001): LEED/Auger/loss study. Taylor, T.N.; Rogers, J.W. Jr.; Ellis, W.P. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Vac. Sci. Technol.;* **16**: No. 2, 581-583(Mar 1979).

The (0001) crystal face of Bi and its reaction with oxygen have been studied using LEED, Auger electron spectroscopy, and electron loss measurements. Loss spectra from the clean surface included two peaks from the 5d levels, a 14-eV bulk plasmon loss, and a 6.5-eV loss which like that from a surface plasmon became more pronounced with decrease in incident electron energy. Room-temperature exposure to 10^4 L of oxygen was necessary before the onset of appreciable chemisorption and the development of overlayer diffraction features. For the oxidized condition, the 5d loss peaks were seen to shift away from the elastic peak while the 6.5-eV loss was replaced by one at 9.3 eV.

39155 Quantum-statistical model for high-density matter. More, R.M. (University of California Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., A;* **19**: No. 3, 1234-1246(Mar 1979).

A new statistical model [the quantum-statistical model (QSM)] was recently introduced by Kalitkin and Kuzmina for the calculation of thermodynamic properties of compressed matter. This paper examines the QSM and gives (i) a numerical QSM calculation of pressure and energy for aluminum and comparison to existing augmented-plane-wave data; (ii) display of separate kinetic, exchange, and quantum pressure terms; (iii) a study of electron density at the nucleus; (iv) a study of the effects of the Kirzhnitz-Weizsacker parameter controlling the gradient terms; (v) an analytic expansion for very high densities; and (vi) rigorous pressure theorems including a general version of the virial theorem which applies to an arbitrary microscopic volume. It is concluded that the QSM represents the most accurate and consistent theory of the Thomas-Fermi type.

39156 Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states. Pickett, W.E.; Ho, K.M.; Cohen, M.L. (Department of Physics, University of California and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., Sect. B. Condens. Matter;* **19**: No. 4, 1734-1750(15 Feb 1979).

The self-consistent-pseudopotential method is applied to the A-15 compounds Nb_3Ge and Nb_3Al. The Fermi energy is found to lie in a region of very flat bands having a bonding character along the Nb chains. Comparison with the band structures of the (nonexistent) A-15 materials Nb_3Nb and Nb_3/sup asterisk/ (chains only) suggest that the p states on the Ge and Al atoms are instrumental in determining the position of the Fermi level. There is little evidence for rigid-band behavior in the Nb_3Al/sub x/Ge/sub 1-x/ system. Studies of the effects of chain dimerization in Nb_3Ge suggest that states at R and M are more likely candidates to participate in structural transitions than states at Γ or X.

39157 Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation. Ho, K.M.; Pickett, W.E.; Cohen, M.L. (Department of Physics, University of California and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., Sect. B. Condens. Matter;* **19**: No. 4, 1751-1761(15 Feb 1979).

Electron charge distributions are presented for Nb_3Ge, Nb_3Al, and two other hypothetical A-15 structures. Results indicate that the bonding in these materials is mainly metallic in character with some covalentlike bonding between Nb-chain atoms. We find significant coupling between neighboring chains and also between chain atoms and atoms at the cubic site. Comparison is made with various theoretical models. Investigation of the charge character of states near E/sub F/ suggests further developments in current theories on the structural transformation of A-15 compounds. The effect of chain dimerization on electronic states and charge distribution of Nb_3Ge is also investigated.

39158 X-ray absorption fine structure above the Ti L edge. Denley, D.; Williams, R.S.; Perfetti, P.; Shirley, D.A.; Stoehr, J. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Phys. Rev., Sect. B. Condens. Matter;* **19**: No. 4, 1762-1768(15 Feb 1979).

We report the first measurement of an EXAFS signal from an L edge in the intermediate-energy range 200—1000 eV, obtained using synchrotron radiation and by the use of a specially designed multielement detector system. Observations of the near-edge absorption fine structure show the hole-state spin-orbit splitting and give clear evidence that the Ti L edge exhibits a "white line." In addition, pronounced oscillations were observed in the absorption spectrum, extending at least 350 eV above the edge. Three peaks were observed in the Fourier-transform signal, corresponding to first-, second-, and fourth-neighbor distances. Derived phase shifts were consistent with a predominant d-wave character in the continuum final state.

39159 Self-consistent mixed-basis approach to the electronic structure of solids. Louie, S.G.; Ho, K.; Cohen, M.L. (IBM Thomas J.Watson Research Center, Yorktown Heights, New York 10598). *Phys. Rev., Sect. B. Condens. Matter;* **19**: No. 4, 1774-1782(15 Feb 1979).

A mixed-basis method is developed for the calculation of the electronic structure of solids. The method is shown to be capable of treating crystals with large complex unit cells. A combined set of plane waves and Bloch sums of localized functions is employed as basis functions, thus leading to a very efficient representation of systems which contain both highly localized (atomiclike) and delocalized (plane-wave-like) electrons. The crystalline potential is determined in a fully self-consistent manner with no approximations made to its shape. The present method has the flexibility of being easily applicable to the study of many different systems (e.g., surface calculations with supercells). Specific application is made to bulk Nb and Pd to demonstrate the efficiency and accuracy of the method. Very good agreement with experimental results and with band structures calculated using other methods is obtained. It is found that, with a mixed basis, only a relatively small set of functions is needed to obtain convergent wave functions for the electrons.

39160 Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds. Sinha, S.K. (Argonne National Lab., IL). pp 489-589 of Handbook on the physics and chemistry of rare earths. Gschneidner, K.A. Jr.; Eyring, L. (eds.). Amsterdam, Netherlands; North-Holland Publishing Co. (1978).

A review of the research on lanthanide magnetism from both elastic and inelastic neutron scattering was made. Magnetic properties follow from the basic property of the unfilled shell of 4f electrons which is well separated from the conduction band electrons and also well localized on the ion sites so that direct f-shell overlap or exchange effects are negligible. (FS)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 38053, 38061, 38068, 38126, 38473, 38626, 38628, 38686, 38807, 39078, 39165

39161 (INIS-mf—4506, pp v) **Nuclear pressure boundary materials research, problems and proposed solutions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The complete text discusses several important materials problems facing LWR operation and some of the research programs that have been formulated at EPRI to address these problems. The problems include steam generator corrosion damage, BWR pipe cracking, BWR nozzle corner cracking, and radiation induced embrittlement. LWR materials problems are complex and will not easily yield to solution. However, the economic rewards for the solutions are great.

39162 Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium. Sharp, D.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Vac. Sci. Technol.;* **16**: No. 2, 204-207(Mar 1979).

Accelerated and long term corrosion data are presented for the Ti—Ag and Cr—Au thin film metallization systems deposited by sputter deposition. The Ti—Ag conductor system is used as an electrode for high intensity silicon solar cells, and it has been found that an intermediate layer of 1500 A of palladium greatly improves the environmental stability of the metallization. The Cr—Au system has been used as an electrical circuit pattern, and thin films of palladium (100—300 A) have been incorporated to improve storage, processing, and service stability. A 100 A palladium intermediary did not affect the etch patterning of the Cr—Au metallization. It is observed that the introduction of palladium modifies the anodic potential of the active metal producing a passive oxide when exposed to an electrolytic environment. It is proposed that this modified oxide, at exposed pinhole sites, is responsible for the increased corrosion resistance when palladium is present as an intermediate layer for either the Ti—Ag or Cr—Au metallization systems.

39163 Radiation damage profile of compensated p-type germanium irradiated with fast electrons. Mamontov, A.M.; Balashov, A.P. *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 12, 1427-1428(Dec 1978).

Stacks of p-tpe germanium wafers (doped with mercury and compensated with antimony) were irradiated with 5 and 8.5 MeV electrons in various doses at room temperature. The results indicated that a dose of the order of 5 x 10^{14} cm^{-2} largely flattened the resistivity profiles in the samples. This is due to deactivation of the antimony donors and mercury acceptors. It provides a method for suppressing or establishing resistivity gradients in samples up to 1 cm thick. (AIP)

39164 Characteristics of radiation damage of silver-doped p-type germanium. Mamontov, A.M.; Baryshev, N.S.; Polozova, I.E. *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 12, 1430-1431(Dec 1978).

Samples of p-type germanium doped with silver and compensated with antimony were irradiated with 8.5 MeV electrons at room temperature. The main result was an increase in the hole density. This was attributed to an increase in the concentration of the "active" silver at the lattice sites. (AIP)

39165 Materials. Schneider, S.J.; Frederikse, H.P.R., Telegin, G.P.; Romanov, A.I. pp 535-621 of Open-cycle magnetohydrodynamic electrical power generation. Petrick, M.; Shumyatskii, B.Ya. Argonne, IL; Argonne National Laboratory (1978).

The status of materials development in MHD is set forth through discussions of the scope and nature of the materials problems, definition of materials selection criteria and condidate materials, and descriptions of materials performance under actual or close-to-actual MHD conditions. The material requirements are defined for the high-temperature MHD components such as electrodes, insulators, combustors, air preheaters, refractory liners, and downstream metallic components such as boilers, heat recuperators, etc. Chemical and physical property data are tabulated for various candidate high-temperature ceramics, metals, alloys, and refractory concretes. 155 references. (WHK)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 38822, 39466

39166 (EUR—5667(Pt.2), pp 1-23) **Radiation-induced defect production in structural materials at reactor temperatures.** Beeler, J.R. Jr.; Beeler, M.F. (North Carolina State Univ., Raleigh (USA). Dept. of Engineering Research); Brudnoy, D.M. (Knolls Atomic Power Lab., Schenectady, N.Y. (USA)). 1977.

From 1. ASTM-Euratom symposium on reactor dosimetry; developments and standardization; Petten, Netherlands (22 Sep 1975).

Computer experiment results on the defect structures formed during short-term annealing of displacement spikes in structural materials and the spatial distribution of these defects are reviewed. Electron, neutron and ion irradiation defect states are compared. Differences in the defect states produced by fission reactor and fusion reactor neutron irradiation are noted.

39167 (PNL—2805) **Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel.** Dudder, G.B.; Atteridge, D.G.; Davis, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1978. Contract EY-76-C-06-1830. 30p. Dep. NTIS, PC A03/MF A01.

The applicability of various NDT techniques for detecting thin layers of ferrite on Type 316 stainless steel cladding was studied. The ability to detect sodium-induced ferrite layers on fuel pins would allow an experimental determination of the fuel pin temperature distribution. The research effort was broken down into three basic sections. Phase one consisted of a theoretical determination of the ferrite detection potential of each of the propsed NDT techniques. The second phase consisted of proof-of-principle experiments on the techniques that passed phase one. The third phase consisted of in-hot cell testing on actual EBR-II fuel pins. Most of the candidate techniques were eliminated in the first phase of analysis. Four potential techniques passed the initial phase of analysis but only three of these passed the second analysis phase. The three techniques that passed the proof-of-principle section of analysis were heat tinting, magnetic force and electromagnetic techniques. The electromagnetic technique was successfully demonstrated on actual fuel pins irradiated in EBR-II in the third phase of analysis while the other two techniques were not carried to the hot cell analysis phase. Results of this technique screening study indicates that an electromagnetic and/or heat tinting ferrite layer NDT technique should be readily adoptable to hot cell inspection requirements. It wasalso concluded that the magnetic force technique, while feasible, would not readily lend itself to hot cell fuel pin inspection.

39168 (SAND—79-0497C) **Application of ion channeling to radiation damage studies.** Picraux, S.T. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. Dep. NTIS, PC A02/MF A01.

A brief summary of the ion channeling technique is presented as it applies to the study of radiation damage. Primary emphasis is given to recent advances which allow quantitative depth profiling studies of intrinsic defects in metals.

39169 (UCRL—82159) **Positron lifetime study of copper irradiated by energetic protons or energetic neutrons.** Howell, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 4p. (CONF-790437—2). Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Positron lifetime measurements of pure copper damaged by irradiation with energetic protons and neutrons are presented. Lifetime determinations of the bulk material and various traps were made, and the dependence of the trapping rate on dose and irradiation energy were investigated. The results from the neutron- and proton-irradiated samples point to the existence of traps with similar but distinct lifetime parameters, not varying greatly from values reported in deformation studies. Also, a trap with long lifetime is seen for some proton irradiations, but is never seen for the neutron irradiations. The trapping rate of the short-lifetime trap is a linear function of dose for proton-irradiated samples and nearly so for the neutron irradiation. 1 figure.

39170 Resonant coherent excitation of channeled ions. Moak, C.D.; Datz, S.; Crawford, O.H.; Krause, H.F.; Dittner, P.F.; Campo, J.G.d.; Biggerstaff, J.A.; Miller, P.D.; Hvelplund, P.; Knudsen, H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **19**: No. 3, 977-993(Mar 1979).

The hydrogenlike ions B^{4+}, C^{5+}, N^{6+}, O^{7+}, and F^{8+}, and the heliumlike ion F^{7+} have been shown to exhibit resonant coherent excitation from the atomic level n = 1 to n = 2, caused by the periodic potential oscillations which occur as the ion moves in axial and nearly axial planar channels in thin crystals of Au and Ag. Various harmonics of the lattice-string periodicity are effective, at certain critical ion velocities, in reducing the number of one-electron ions which survive passage through the crystal without electron loss. Resonances, appearing as minima in the one-electron charge-state fraction versus velocity, have been found for several axial channels and for several different harmonics of the string frequencies. In some cases the resonances can be split by small crystal tilts which produce sidebands upon the string frequency. Certain harmonics have been shown to produce tilt-insensitive double minima which measure Stark splittings of the n = 2 levels.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 38972

39171 (PB—283416) **Technology assessment of advanced composite materials. Phase I. Final report.** Kaiser, R. (ARGOS Associates, Inc., Winchester, MA (USA)). Apr 1978. 238p. NTIS PC A11/MF A01.

The principal high performance fibers currently used in advanced composites are graphite, aramid, and boron. In the future, these will be supplemented by other high strength fibers such as alumina, silicon carbide, and boron nitride. Organic matrix composites, which are evolutionary products of fiberglass reinforced plastics, predominate the technology. Carbon matrix composites, now mainly used in missile components and aircraft brakes, may find medical use as implantable substitutes for bone structures. Metal matrix composites are currently used in aerospace applications of a developmental nature. With further technical development, metal matrix composites, especially short fiber composites, may be used in

specialty applications, particularly in energy conversion systems. Areas of application of advanced composites that could result in significant secondary impacts are automotive equipment, general and commercial aviation, agriculture, and the industrialization of space. Advanced composites can be a major tool for petroleum energy conservation, especially in transportation.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 38227, 39099, 39227

39172 Effects of vacuum processing erbium dideuteride/ditritide films deposited on chromium underlays on copper substrates. Provo, J.L. (General Electric Company, Neutron Devices Department, St. Petersburg, Florida 33733). *J. Vac. Sci. Technol.;* **16**: No. 2, 230-232(Mar 1979).

Thin films of erbium dideuteride/ditritide have been experimentally produced on chromium underlays deposited on copper substrates. The chromium underlay is required to prevent erbium occluder/copper substrate alloying which inhibits hydriding. Data taken has shown that vacuum processing affects the erbium/chromium/copper interaction. With an in situ process in which underlay/occluder films are vacuum deposited onto copper substrates and hydrided with no air exposure between these steps, data indicates a minimum of 1500 A of chromium is required for optimum hydriding. If films are vacuum deposited as above and air-exposed before hydriding, a minimum of 3000 A of chromium was shown to be required for equivalent hydriding. Data suggests that the activation step (600°C for 1 h) required for hydriding the film of the second type is responsible for the difference observed. Such underlay thickness parameters are important, with regard to heat transfer consideration in thin film hydride targets used for neutron generation.

STRUCTURE AND PHASE STUDIES

39173 (CONF-790341—2) **Lattice shear distortions in fluorite structure oxides.** Faber, J. Jr.; Mueller, M.H.; Hitterman, R.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

Crystallographic shear distortions have been observed in fluorite structure, single crystals of UO_2 and Zr(Ca)O_2/sub-x/ by neutron-diffraction techniques. These distortions localize on the oxygen sublattice and do not require the presence of an external strain. The internal rearrangement mode in UO_2 is a transverse, zone boundary q vector = $2\pi/a$ (0.5, 0.0) deformation with amplitude 0.014 A. In Zr(Ca)O/sub 2-x/, the mode is a longitudinal, q vector = 2-/a (0,0,0.5) deformation with amplitude 0.23 A. Cation-anion elastic interactions dominate in selecting the nature of the internal distortion.

39174 (CONF-790341—3) **Structure of the λ-phases of niobium deuterium.** Brun, T.O.; Kajitani, T.; Mueller, M.H.; Westlake, D.G.; Makenas, B.; Birnbaum, H.K. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

Lambda phases of NbD/sub x/ ($0.78 \leqq x \leqq 0.84$), which exist below 220 K, have been studied by neutron and electron diffraction. The observed modulated structure can be described as a deuteron concentration wave in a slightly distorted bcc Nb matrix. The wave-vector is parallel to $< 001 >$, and the wavelength varies from 16.0 A to 21.4 A, increasing with increasing concentration.

39175 (CONF-790341—4) **Modulated ordering Nb-H alloys.** Kajitani, T.; Brun, T.O.; Mueller, M.H.; Birnbaum, H.K.; Makenas, B.J. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

Ordering reactions in α′ and β-NbH alloys have been investigated using elastic theory. The α′-β and β-λ phase transformations are driven by the elastic interaction in the niobium lattice distorted by the protons on the t-site interstitials. The β phase is shown to have a three dimensional structure. The fundamental period of the long range modulation along the c-axis in the λ-phase, an incommensurated β phase, is approximately 5 lattice constants.

39176 Proton magnetic resonance studies of TiCuH. Bowman, R.C. Jr. (Monsanto Research Corp., Miamisburg, OH); Attalla, A.; Maeland, A.J. Contract EY-76-C-04-0053. *Solid State Commun.;* **27**: No. 5, 501-505(1978).

The TiCuH structure can be described as alternating layers of TiH_2 and Cu atoms and, thus, corresponds to a two-dimensional analog of metal hydrides with CaF_2-type structures. Measurements of the proton relaxation times for TiCuH yield an activation energy of 0.79 eV for hydrogen diffusion. This result strongly suggests the H-atoms in TiCuH jump directly between the tetrahedral sites rather than through the vacant octahedral sites as proposed for H-atom jumps in fcc TiH/sub x/. In addition, the Korringa constant and hydrogen diffusion rate for TiCuH are compared with similar parameters for TiH/sub x/ and several ternary titanium hydrides.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 39130, 39135, 39136

39177 (SAND—79-2076C) **Analysis of coatings and thin films using energetic ions.** Borders, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790442—3). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

Energetic ion analysis techniques provide nondestructive information on the depth distribution of atomic composition in the near-surface (1 to 10 μm) region of a solid sample. The techniques are quantitative and are not complicated by the presence of chemical or matrix effects. Generalized nuclear reaction analysis is described and its application to the measurement of the stoichiometry of Ta_2O_5 films and BeO coatings on Cu—Be is briefly discussed.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 38957, 38962, 38967, 38971, 38978, 39165

39178 Automated system for electrical field-polarization studies in ferroelectrics. Yarberry, V.R.; Fritz, I.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Rev. Sci. Instrum.;* **50**: No. 5, 595-601(May 1979).

An automated system for measuring dielectric polarization as a function of applied electric field and time has been developed. This system, which is based on the Sawyer—Tower technique for obtaining ferroelectric hysteresis loops, is built around a programmable high-voltage power supply and an automatic data acquisition system, both commercially available. The system can be used for obtaining well-resolved hysteresis loops at rates approaching 10 Hz, and also for measuring the time dependent response to steps in electric field with resolution on the order of 2 ms. Examples of data obtained on a ferroelectric ceramic material are presented.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 38962, 38971, 39165

39179 (SAND—79-0413C) **Boron nitride ablation studies in arc jet facilities.** Sheldahl, R.E.; Wright, G.F. Jr.; Beard, S.G. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 26p. (CONF-790505—1). Dep. NTIS, PC A03/MF A01.

From 25. ISA international instrumentation symposium; Anaheim, CA, USA (7 May 1979).

The use of boron nitride as an ablative material for antenna windows on high performance reentry vehicles necessitated an experimental study of its ablative behavior and thermal response in severe thermal environments. Boron nitride specimens were tested in three arc jet test facilities and the measured thermal response of the specimens shows good to excellent agreement with the results of computer analysis. Further studies are necessary to characterize the ablation mechanism of the molten material recorded in motion pictures.

39180 Radio-frequency-sputtered tetragonal barium titanate films on silicon. Panitz, J.K.G.; Hu, C. (University of New Mexico, Albuquerque, New Mexico 87131). *J. Vac. Sci. Technol.;* **16**: No. 2, 315-318(Mar 1979).

Polycrystalline films of $BaTiO_3$ displaying electron diffraction patterns identical to that of bulk tetragonal $BaTiO_3$ and ferroelectric properties are regularly observed for $BaTiO_3$ films thicker than 1000 A rf-sputtered deposited at 5 A/min onto silicon substrates at temperatures above 500°C. A severe interaction problem between the silicon substrate and the $BaTiO_3$ contaminates the film, but can be avoided by growing a passivation barrier of SiO_2 on the silicon substrate before depositing $BaTiO_3$. Despite a coefficient of thermal expansion mismatch between $BaTiO_3$ and silicon, thin films with good electrical insulation properties can be obtained by reducing the substrate temperature during the deposition by 7.0°C/min to a final substrate temperature of 200°C.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 38671, 38754

POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 38114

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 39096

STRUCTURE AND PHASE STUDIES

39181 (CONF-790415—24) **Static correlations in semidilute polymer solutions.** Schaefer, D.W.; Hendricks, R.W. (Sandia Labs., Albuquerque, NM (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

This document reports small-angle x-ray scattering measurements of the concentration dependence of the correlation ranges in semi-dilute solutions of polystyrene in butanone. Results confirm the assumption that xi scales with concentration C (xi ~ C^{-}/sup x/) and xi are independent of the molecular weight. (DLC)

MECHANICAL PROPERTIES

39182 (UCRL—52434(Vol.4)) **Development of alternate silicone potting compounds. Vol.4. Development of a substitute for Dow Corning's aerospace sealant DC 93-120 resin cured with DC 93-122 curing agent.** Cady, W.E.; Buckner, A.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jan 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

A substitute for Dow Corning DC 93-120 silicone potting resin cured with DC 93-122 silicon curing agent can be formulated from Dielectric Gel Q3-6527, accelerator QCF3-6559, and DC 1107 fluid. The substitute is much lower in viscosity than the material it replaces, but it is equally fast setting, friable, and weak as measured by butt-tensile strength to aluminum. Evaluations are described for two lots of Q3, three lots of DC 1107, and two lots of accelerator. The 1107 and accelerator are minor components whose lot-to-lot variations are not significant. The only significant variable is the reaction rate of the Q3. Because Q3 cannot be activated by the platinum-containing accelerator alone to a gel time of 15 min, the active hydrogen concentrate DC 1107 is needed. Using both accelerator and 1107 in proportions to minimize 1107 is preferred because this decreases the likelihood of porosity in the cured potting compound.

DEGRADATION AND EROSION

39183 **Experimental application of design principles in corrosion research.** Smyrl, W.H.; Pohlman, S.L. (Sandia Labs., Alburquerque, NM). *Corrosion;* **35**: No. 4, 170-174(Apr 1979).

Experimental design criteria for corrosion investigations are based on established principles for systems that have uniform, or nearly uniform, corrosive attack. Analysis reveals how experimental parameters influence behavior, and in particular how the use of dimensionless groups help to evaluate the competing influences of different parameters. This measure of the relative importance of interfacial kinetics, solution conductivity, and mass transfer, provides a basis for designing laboratory experiments for materials testing and selection, and for scaling laboratory measurements to service conditions. Some applications to materials protection are brifly discussed, as well as the extension to the galvanic attack that occurs on a substrate through holes in a protective overplate.

RADIATION EFFECTS

39184 (N—78-31252) **Proton and electron irradiation of thermal control coatings and polymeric films. I. Experimental irradiations.** Paillous, A.; Amat, M.T.; Marco, J.; Panabiere, G. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France)). Sep 1977. Contract ESTEC-2838/76-NL-HP(SC). 106p. NTIS PC A06/MF A01.

A theoretical study based on literature results has shown that the variation of the optical absorption coefficient of certain thermal control coatings under special radiation conditions is a direct function of the average value of the energy dosage absorbed in the degraded layer of the material. An experimental program was set up to confirm these results. The spectral degradations of the reflection factors of coatings irradiated with 210, 80 and 40 keV electrons and with 150, 75 and 45 keV protons are presented. The materials studied ere Kapton and aluminized Teflon, the white paints PSG 120 and PSZ 184, polyethylene terephthalate, a silicon dioxide sheet, and various other polymeric films.

39185 (N—78-31253) **Proton and electron irradiation of thermal control coatings and polymeric films. II. Theoretical irradiations. Final report.** Bourrieau, J. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France)). Feb 1978. Contract ESTEC-2838/76-NL-HP(SC). 80p. NTIS PCA05/MF A01.

Mathematical models for the degradation of thermal control coatings by irradiation with charged particles are described and the results obtained by irradiating various materials with low energy protons and electrons are given. The models are based on the hypothesis that solar reflectance variations are induced by color centers of which the concentration in the irradiated zone depends only on the dosage. This hypothesis was verified. The sensitivity curves (variation of the optical absorption coefficient with the dosage) were recorded for Teflon, Kapton and the paints PSZ 184; the optical thickness of the latter was also obtained. The sensitivity curves of Terphane depend on the energy and the nature of the particles; a threshold reaction is probable.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 38370, 38376, 38388, 39497

39186 (AD-A—057503) **Development of intercalated graphite materials. Final technical report 1 August 1976—30 September 1977.** Hanlon, L.R. (Pennsylvania Univ., Philadelphia (USA). Moore School of Electrical Engineering). Apr 1978. Contract F33615-75-C-5231. 79p. NTIS PC A05/MF A01.

Graphite intercalation compounds were prepared from high-oriented pyrolytic graphite and AsF5 by direct vapor phase synthesis. These compounds were characterized by x-ray and gravimetric analysis and by measurement of the c-axis thickness increase. The c-axis thickness increase proved to be a reliable indicator of stage for stages 1-3; the stochiometry of those stages was found to be C8nAsF5, where n = stage. Room temperature measurements of the optical reflectance were performed from .07-2.0 eV. The compounds showed metallic behavior; the IR reflectance was high and analysis of the plasma edge suggested a high electrical conductivity. This was confirmed by r.f. (100 kHz) eddy-current loss measurements which showed the basal-plane conductivity as high as that of silver. Stability of the stage 3 compounds in air is very good; one sample has shown essentially no change in conductivity after 7100 hours in air. Preliminary work with intercalation of graphite fibers is also reported here; the results of that work are also promising.

39187 (UCID—18077) **Large-area boron and carbon scatterers and filters.** Woehrle, T.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Mar 1979. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

A technique was developed for making large-area boron and carbon scatterers or filters for use on nuclear field experiments and in the ion accelerator/subkilovolt x-ray facility in the Lawrence Livermore Laboratory. These scatterers and filters were made by spraying a mixture of boron in ethyl alcohol or of carbon in isopropyl alcohol on a backing material of 0.00185-cm polyethylene (-CH_2CH_2-). In place of the polyethelene, any suitable backing material can be used.

39188 **Copper sulfide films deposited by cylindrical magnetron reactive sputtering.** Jonath, A.D.; Anderson, W.W.; Thornton, J.A.; Cornog, D.G. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). *J. Vac. Sci. Technol.;* **16**: No. 2, 200-203(Mar 1979).

Copper sulfide coatings 150 nm thick were deposited by reactive sputtering using a copper cylindrical magnetron sputtering source in an Ar—H_2S atmosphere at constant discharge current and varies H_2S injection rates. Borosilicate plate-substrates were maintained at temperatures of 130° and 35°C, which are above and below transition temperatures for the Cu/sub x/S phases of interest. Above a critical injection rate resistivity data indicate two types of materials: a high-resistivity type (~100 Ω cm) often exhibiting Cu-rich nodules, and a low-resistivity type (~0.01 Ω cm). The types are generally associated with the high and low substrate temperatures respectively. Hall mobilities were in the 1—6 cm^2/V s range for both materials. Optical absorption, resistivity-versus-temperature, and x-ray diffraction measurements indicate that the high resistivity material consists largely of near-stoichiometric chalcocite and that the low resistivity material is a mixture of chalcocite and djurleite.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 39954

39189 Bonding at the Si (111)—SiO_2 interface: stoichiometry and kinetics probed with synchrotron radiation photoemission spectroscopies. Bauer, R.S. (Xerox Palo Alto Research Center, Palo Alto, CA); McMenamin, J.C.; Bachrach, R.Z.; Bianconi, A.; Johansson, L.; Petersen, H. pp 797-800 of Physics of semiconductors, 1978. Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979).

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

The interface between SiO_2 formed by in situ dosing Si (111) 2 x 1 as a function of temperature, pressure, and O_2 excitation was probed using the unique tunability of soft x-ray synchrotron radiation. The transition between bulk Si and SiO_2 stoichiometries can be atomically abrupt (i.e., 385 A thick in the [111] direction) with a Si inter-double-layer bond replaced by Si_2O. This bond is characterized by a 1.6 eV chemical shift for Si (2p) core electrons. The oxidation proceeds beneath the first Si double-layer either by growth along (110) steps or by diffusion through the peroxy-radical saturated surface. The oxide thickness is limited to one or two double-layers by the kinetics at 700 +- 50°C in uhv. At higher growth or annealing temperature, dissociation or evaporation as suboxides occurs, leaving only elementally bonded Si.

39190 Phonons and charge density waves in 1T-$TiSe_2$. Wakabayashi, N. (Oak Ridge National Lab., TN); Smith, H.G.; Woo, K.C.; Brown, F.C. Contract W-7405-ENG-26. *Solid State Commun.;* **28**: No. 11, 923-926(1978).

Inelastic neutron scattering measurements have been carried out on 1T-$TiSe_2$ at various temperatures in order to obtain information about the dynamics of the phase transition associated with the charge density waves. A large damping of a transverse phonon at the L-point has been observed near the transition temperature. A simple lattice dynamical model was used to study the effect of the Ti—Se bonding on the transition.

PROPERTIES

REFER ALSO TO CITATION(S) 38398, 38480, 38541, 39130, 39186, 39951, 39952, 39953

39191 (SAND—78-1198) **Design of an aging and compatibility test for materials in the MC-2802 fireset.** Arnold, C. Jr.; Bailey, M.E.; Smith, H.M. (Sandia Labs., Albuquerque, NM (USA); Bendix Corp., Kansas City, MO (USA)). Apr 1979. Contract AC04-76DP00789. 13p. Dep. NTIS, PC A02/MF A01.

The degradation of the properties of materials with time can result in the functional failure of components in a weapon system. In the past, it was the practice to age components to failure, but since the materials in the component which caused the failure were often not in a testable configuration, it was not possible to correlate failure with the extent of material degradation. Quantitative aging characteristics of materials are required to predict the service life of the materials and the component in a more reliable way. A test plan is described in which selected materials will be aged either singly or in various combinations to overcome the above described limitations. The rationale that was used to select the materials, aging temperatures and test methods is discussed.

39192 Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films. Prince, E.T.; Helbig, H.F.; Czanderna, A.W. (Department of Physics, Clarkson College of Technology, Potsdam, New York 13676). *J. Vac. Sci. Technol.;* **16**: No. 2, 244-247(Mar 1979).

An apparatus consisting of a vacuum ultramicrobalance and optical equipment for measuring transmittance and front surface reflectance of thin films from 400 to 800 nm is described. Thin films formed on substrates by thermal or reactive evaporation can be heated in reactive gases of different compositions and pressures. As the chemical composition of the film changes, the optical changes in the film can be monitored simultaneously using computerized data collection, control, and analysis.

39193 Ultrasonic study of a smectic-B liquid crystal. Bhattacharya, S.; Shen, S.Y.; Ketterson, J.B. (Department of Physics and Astronomy and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., A;* **19**: No. 3, 1211-1218(Mar 1979).

Anisotropy in the velocity and attenuation of longitudinal ultrasound was studied for the first time in a stable smectic-B liquid crystal (β-methyl-butyl-methoxybenzylidene amino cinnamate). Anisotropy in the velocity was found to be consistent with the predictions of the Martin-Parodi-Pershan hydrodynamic theory in both smectic-A and -B phases, but was significantly smaller than when measured in the same material by Brillouin scattering. Furthermore, strong dispersion was observed near the smectic-A—smectic-B phase transition for sound propagating perpendicular to the symmetry direction.

39194 Anisotropic ultrasound propagation in a smectic-A liquid crystal. Bhattacharya, S.; Shen, S.Y.; Ketterson, J.B. (Department of Physics and Astronomy and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., A;* **19**: No. 3, 1219-1224(Mar 1979).

Anisotropic ultrasound propagation was studied in a magnetically aligned monodomain smectic-A liquid crystal (di-n-decyl azoxy methyl cinnamate). A large attenuation was observed near the isotropic-smectic-A phase transition. The anisotropy in the sound velocity was found to be in agreement with the predictions of hydrodynamic theory, and no dispersion was found in the frequency range used (4—12 MHz). The temperature dependence of the physically meaningful elastic constants was determined. The anisotropy in the attenuation was also measured. Unlike the velocity anisotropy, no intermediate minimum was observed.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 38480

39195 Construction and thermodynamic performance of an Ag—AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S. Danielson, M.J. (Battelle Pacific Northwest Labs., Richland, WA). Contract EY-76-C-06-1830. *Corrosion;* **35**: No. 5, 200-204(May 1979).

An Ag—AgCl reference electrode for temperatures to 250°C has been demonstrated to have a Nernstian response by use of concentration cells with transference. A ZrO_2 electrode body acting as a diffusion barrier has been incorporated which permits thermodynamic operation at high temperatures in environments containing significant quantities of H_2 and H_2S.

RADIATION EFFECTS

39196 (CONF-781121—22) **New materials properties achievable by ion implantation doping and laser processing.** Appleton, B.R.; Larson, B.C.; White, C.W.; Narayan, J.; Wilson, S.R.; Pronko, P.P. (Oak Ridge National Lab., TN (USA)). Dec 1978. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From Annual meeting of Materials Research Society; Boston, MA, USA (28 Nov 1978).

It is well established that ion implantation techniques can be used to introduce selected impurities into solids in a controlled, accurate and often unique manner. Recent experiments have shown that pulsed laser processing of materials can lead to surface melting, dopant redistribution and crystal regrowth, all on extremely short time scales ($\sim < 1$ μ sec.). These two processes can be combined to achieve properties not possible with normal materials preparation techniques, or to alter materials properties in a more efficient manner. Investigations are presented utilizing the combined techniques of positive ion scattering-channeling, x-ray scattering and transmission electron microscopy which show that supersaturated alloys can be formed in the surface regions ($\sim$ 1 μm) of ion implanted, laser annealed silicon single crystals, and that these surfaces undergo a unique one dimensional lattice contraction or expansion depending on the dopant species. The resultant surface has a lattice parameter significantly different from the bulk, is free from any damage defects, has essentially all the dopant atoms in substitutional sites and the impurity concentrations can exceed solid solubility limits by more than an order of magnitude.

39197 (N—78-28604) **Simulation of space radiation effects on polyimide film materials for high temperature applications. Final report.** Fogdall, L.B.; Cannaday, S.S. (Boeing Aerospace Co., Seattle, WA (USA)). Nov 1977. Contract JPL-954701. 42p. NTIS PC A03/MF A01.

Space environment effects on candidate materials for the solar sail film are determined. Polymers, including metallized polyimides that might be suitable solar radiation receivers, were exposed to combined proton and solar electromagnetic radiation. Each test sample was weighted, to simulate the tension on the polymer when it is stretched into near-planar shape while receiving solar radiation. Exposure rates up to 16 times that expected in Earth orbit were employed, to simulate near-sun solar sailing conditions. Sample appearance, elongation, and shrinkage were monitored, noted, and documented in situ. Thermosetting polyimides showed less degradation or visual change in appearance than thermoplastics.

39198 Mechanism of low-temperature formation of Watkins-type radiation defects in semiconductors. Klinger, M.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Phys. - Semicond. (Engl. Transl.);* **12**: No. 12, 1363-1367(Dec 1978).

A mechanism is proposed for low-temperature formation of radiation defects in semiconductors involving a very strong enhancement of the diffusion process. A qualitative theory of this mechanism is provided. The main relationships describing the defect-formation

process and its characteristics are derived and analyzed; the criteria of the process are also derived.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 38291

39199 (ANL—78-65(Pt.2), pp 163-166) **Method for the determination of ^{241}Am in urine.** Larsen, R.P.; Walkup, R.E.; Oldham, R.D. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

An alpha spectrometric—isotopic dilution method has been developed for and applied to the determination of ^{241}Am in urine. The limit of detection at the 95% confidence level is 200 μBq when a 24-hr counting period is used. A known amount of ^{243}Am is added to the sample, the organic constituents are destroyed by wet ashing, and the americium is separated from the other inorganic constituents. The americium is deposited on a planchet by electroplating, and the planchet is assayed in an alpha spectrometer to determine the ^{241}Am to ^{243}Am activity ratio. Americium recovery in the procedure ranges from 80 to 90%.

39200 (MHSMP—79-15) **FE-NMR analysis of silane hydrogen, phenyl, and vinyl content of several siloxane pre-polymer materials.** Clink, G.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Mar 1979. Contract EY-76-C-04-0487. 9p. Dep. NTIS, PC A02/MF A01.

The vinyl contents of siloxane pre-polymer materials were determined by proton FT-NMR. It was determined that the presence of silane hydrogen in these pre-polymers compromises and in some cases negates vinyl content data reported by use of the iodine monochloride procedure. The active hydrogen species reacts with ICl and produces high iodine numbers, even if no vinyl is present. Siloxane aromatic compounds have also been detected by proton FT-NMR, and they also function as an interfering species and produce high iodine numbers by the ICl procedure.

39201 (PB—285438) **Intercomparison of plutonium-239 measurements. Final report.** Ziegler, L.H. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Jun 1978. 17p. NTIS PC A02/MF A01.

In 1977 the U.S. Environmental Protection Agency distributed calibrated solutions of plutonium-239 to laboratories interested in participating in an intercomparison study of plutonium analysis. Participants were asked to perform a quantitative radioactivity analysis of the solution. The results reported by all the participating laboratories are given here. Eighty-eight percent of the reported activity values were within plus or minus 20 percent of the activity value certified by the Environmental Protection Agency.

39202 (PB—286483) **Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77.** Pellizzari, E.D.; Zweidinger, R.A.; Erickson, M.D. (Research Triangle Inst., Durham, NC (USA)). Jun 1978. Contract EPA-68-01-1978. 165p. NTIS PC A08/MF A01.

The contents include: analytical protocols--(scanning electron microscopy and energy dispersive x-ray analysis; total bromine and chlorine by neutron activation analysis; analysis for ethylene in ambient air; sampling and direct analysis for methyl chloride and methyl bromide in ambient air; sampling and analysis for methyl chloride, methyl bromide, vinyl chloride and vinyl bromide in ambient air; sampling and analysis for chlorinated and brominated hydrocarbons and other chemicals in ambient air; chlorine/bromine sampling and analysis in ambient air; determination of inorganic fluoride in ambient air; acid mist sampling in ambient air; sampling and analysis of volatile halogenated hydrocarbons in soil, sediment, water, vegetation and milk; sampling and analysis of semi-volatile halogenated hydrocarbons in air, soil, sediment, water and biota; ozone measurements); 2) atmospheric dispersion modeling; 3) meteorological data; and 4) hourly ozone concentrations in El Dorado, Arkansas.

39203 (UCRL—52532(Vol.4)(Pt.1)) **Computer automation of continuous-flow analyzers for trace constituents in water. Volume 4. Description of program segments. Part 1. TAAIN.** Crawford, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jan 1979. Contract W-7405-ENG-48. 48p. Dep. NTIS, PC A03/MF A01.

This report describes TAAIN, the first program in the series of programs necessary in automating the Technicon AutoAnalyzer. A flow chart and sequence list that describes and illustrates each logical group of coding, and a description of the contents and functions of each section and subroutine in the program is included. In addition, all arrays, strings, and variables are listed and defined, and a sample program listing with a complete list of symbols and references is provided.

39204 (UCRL—52594) **Automating the Analytical Laboratories Section, Lewis Research Center, National Aeronautics and Space Administration: a feasibility study.** Boyle, W.G.; Barton, G.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Mar 1979. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

We studied the feasibility of computerized automation of the Analytical Laboratories Section at NASA's Lewis Research Center. Since that laboratory's duties are not routine, we set our automation goals with that in mind. We selected four instruments as the most likely automation candidates: an atomic absorption spectrophotometer, an emission spectrometer, an x-ray fluorescence spectrometer, and an x-ray diffraction unit. Our study describes two options for computer automation: a time-shared central computer and a system with microcomputers for each instrument connected to a central computer. A third option, presented for future planning, expands the microcomputer version. We determine costs and benefits for each option. We conclude that the microcomputer version best fits the goals and duties of the laboratory and that such an automated system is needed to meet the laboratory's future requirements.

39205 **Radioanalytical chemistry in the USA. Continuing a tradition of excellence.** Lyon, W.S. (Oak Ridge National Lab., Tenn. (USA)). *J. Radioanal. Chem.;* **43**: No. 2, 305-307(1978).

The "secret" war-time laboratories of Oak Ridge, Hanford, Los Alamos, and Chicago were the predecessors of the AEC laboratories - now, of course, part of the ERDA complex. The first decade of AEC control was a period in which chemistry was still the primary component of analytical radiochemistry. Two accomplishments of the AEC laboratories that exemplify the importance of the chemist were the establishment of the radioisotope program and the development of neutron activation analysis as an analytical tool. The decade of the 60's was marked by great improvement in instrumental techniques, introduction of neutron generators as laboratory tools, the use of non-neutron sources in activation analysis, the application of nuclear techniques to problems of reactor development, and the opening up of a new research frontier: the actinide elements. Concerns with environment - and lately energy - have put the analytical radiochemist in the ERDA laboratories back at the bench. The demands for lower levels of emitted radioactivity from reactors, the problem of Pu and transuranics in the environment, worries about fuel assay and loss of nuclear materials are some of the problems that have pushed the chemist back to his chemicals and away from the computer. In the age of the computer, the separations chemist is once again coming into his own.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

39206 (NTIS/PS—78/1241) **Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 1. 1964-1976 (a bibliography with abstracts). Report for 1964-1976.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 146p. NTIS PC N01/MF N01.

This bibliography was prepared in order to bring together Federally-funded research relating to archaeology. It is divided into two sections. The first deals with the chemical analysis of archaeological specimens primarily using activation analysis. Articles studied include metals, pottery, coins, paintings, soils, glass, and paper from Medieval, Grecian, Egyptian, Mayan, and prehistoric times. The second section cites other archaeological research, including results of excavations from the United States. Also covered is work on preservation of artifacts and remote sensing for site location. (This updated bibliography contains 137 abstracts, none of which are new entries to the previous edition.)

39207 (NTIS/PS—78/1242) **Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 2. 1977-november, 1978 (a bibliography with abstracts). Report for 1977-Nov 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Nov 1978. 217p. NTIS PC N01/MF N01.

These citations of Federally-funded research are divided into two parts; namely, a chemical analysis of archaeological specimens, and general studies. The chemical analysis section deals primarily with activation analysis. Articles examined include metals, pottery, coins, paintings, soils, glass, and paper from Medieval, Grecian, Egyptian, Mayan and prehistoric times. The general studies section cites other archaeological research, including results of excavation from the United States. Also covered is work on preservation of artifacts and remote sensing for the site location. (This updated bibliography contains 209 abstracts, 141 of which are new entries to the previous edition.)

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 39571

39208 (BMFT-FB-T—78-08) **Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide.** Boehm, H. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (Germany, F.R.). Forschungsinstitut). Nov 1978. 20p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

An electrochemical measuring process for analyzing the air pollutants SO_2, NO_2, NO and unsaturated hydrocarbons was developed. The gas diffusion sensing electrodes produced with electrocatalysts are described. A measuring cell was built and the conditions of operation were determined. For demonstrating the measuring process a portable monitor was designed to detect selectively individual atmospheric pollutants.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 38226, 38239, 38297, 38298, 39679

39209 (PB—284850) **Environmental radioactivity laboratory intercomparison studies program, 1978-1979. Interim report.** (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Jun 1978. 27p. NTIS PC A03/MF A01.

The U.S. Environmental Protection Agency's intercomparison studies program for laboratories involved in environmental radiation measurements is described. The types of environmental samples distributed, the analyses required for each sample, the distribution schedule, and the statistical analysis and reporting of results are discussed. Instructions and application forms are included for laboratories desiring to participate in the program. This document is not a research report. It is designed for use by laboratories participating or desiring to participate in the quality assurance program.

39210 (UCID—18151) **Nuclear chemistry counting facilities: requirements definition.** O'Brien, D.W.; Baker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Apr 1979. Contract W-7405-ENG-48. 53p. Dep. NTIS, PC A04/MF A01.

In an effort to upgrade outdated instrumentation and to take advantage of current and imminent technologies the Nuclear Chemistry Division at Lawrence Livermore Laboratory is about to undertake a major upgrade of their low level radiation counting and analysis facilities. It is expected that such a project will make a more coordinated data acquisition and data processing system, reduce manual data handling operations and speed up data processing throughput. Before taking on a systems design it is appropriate to establish a definition of the requirements of the facilities. This report examines why such a project is necessary in the context of the current and projected operations, needs, problems, risks and costs. The authors also address a functional specification as a prelude to a system design and the design constraints implicit in the systems implementation. Technical, operational and economic assessments establish necessary boundary conditions for this discussion. This report also establishes the environment in which the requirements definition may be considered valid. The validity of these analyses is contingent on known and projected technical, scientific and political conditions.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 38084

39211 (METC/CR—79/5) **Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale.** Renton, J.J. (West Virginia Univ., Morgantown (USA); West Virginia Geological and Economic Survey, Morgantown (USA)). Feb 1979. 26p. Dep. NTIS, PC A03/MF A01.

The intensity of x rays diffracted from a component of a mixture is proportional to the concentration of that component in the mixture. The proportionality constant is, however, affected by various parameters including sample preparation and mounting, equipment operation, the composition and crystallinity of the component and the overall composition of the mixture to name just a few. Assuming critical control of sample preparation, mounting and equipment operation, for a specific sample type, weighting factors were determined which when applied to the observed x ray intensities of the individual minerals allowed a reasonably accurate semi-quantitative estimation of the mineral abundances to be calculated. The effectiveness of the weighting factors was evaluated using both parametric and nonparametric statistical comparisons with other conventional analytical procedures. Because the sample preparation and mounting procedures are critical for the success of this or any other analytical technique, the procedures used are detailed.

39212 (PB—285452) **Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977.** Pella, P.A.; Myklebust, R.L.; Darr, M.M.; Heinrich, K.F.J. (National Bureau of Standards, Washington, DC (USA)). Oct 1976. 32p. NTIS PC A04/MF A01.

Limits of detection for arsenic, vanadium, cadmium, lead and mercury have been determined with a wavelength-dispersive or energy-dispersive spectrometry, or with both, in various matrices consisting of cupric oxide, ferric oxide, lead oxide, coal and fly ash.

39213 **Obsidian hydration profiles measured by sputter-induced optical emission.** Tsong, I.S.T.; Houser, C.A.; Yusef, N.A.; Messier, R.F.; White, W.B. (Pennsylvania State Univ., University Park). *Science;* 201: No. 4353, 339-341(28 Jul 1978).

The variation of concentrations of hydrogen, sodium, potassium, lithium, calcium, magnesium, silicon, and aluminum as a function of depth in the hydration layer of obsidian artifacts has been determined by sputter-induced optical emission. The surface hydration is accompanied by dealkalization, and there is a buildup of alkaline earths, calcium and magnesium in the outermost layers. These results have clarified the phenomena underlying the obsidian hydration dating technique.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 39560, 39571

39214 (CONF-790330—1) **Practical aspects of glass capillary gas chromatography.** Maskarinec, M.P. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From UCC gas chromatography specialists group meeting; Pittsburgh, PA, USA (6 Mar 1979).

Advantages of glass capillary columns over conventional packed columns in the analysis of complex organic mixtures are efficiency, inertness, and very low bleed. Fabrication of columns and instrumental considerations are discussed in this document. 3 figures. (DLC)

39215 (ORNL/TM—6670) **Mass transfer in two-phase nondispersing liquid—liquid contactors with a high-density-difference system.** Brown, C.H. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 105p. Dep. NTIS, PC A06/MF A01.

Mass transfer rates of an electrolyte through a turbulent aqueous film in an agitated two-phase nondispersing liquid—liquid contactor were measured using an aqueous electrolyte solution as the light phase and mercury as the heavy phase. The mass transfer data were correlated by the equation N/sub Sh/ = [0.029 exp(3.3 x 10^{-6}N/sub Re//sub M/)]N/sub Re//sub W/$^{0.81}$N/sub Sc//sub W/$^{0.52}$. The mass transfer rates were measured polarographically via the diffusion-limited, electrically driven reduction of quinone at the mercury surface in the contactor. Variables tested were the agitation rate, agitator diameter, phase volume, cell size, and various physical properties (principally viscosity) of the aqueous phase. The parameters found to be most significant to the mass transfer rate were agitator speed, agitator diameter, and aqueous-phase viscosity. A correlation found in the literature is similar to the correlation developed here, but a new form of the intercept term was developed which correlates mass transfer data over a much wider range of Sherwood numbers than that found in the literature. 33 figures, 7 tables.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 38315, 38849, 38989, 39146, 39238, 39239, 39254, 39538, 39598, 39613, 39782

39216 (AD-A—058229) **Synthesis and characterization of the mixed-metal alkylidyne clusters RcFeCo2(CO)9h (r = CH3, C2H5, C6H5). Interim technical report.** Epstein, R.A.; Withers, H.W.; Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 29 Jul 1978. Contract N00014-77-C-0417. 25p. NTIS PC A02/MF A01.

Reaction of closed metal carbonyl trimers with carbonylmetalates has been shown to be a useful synthetic route to tetranuclear clusters in which the carbonylmetalate adds to the face of the original trimer. This type of reaction has been particularly useful for the synthesis of mixed-metal clusters. In principle, clusters with more than four framework atoms could be prepared by the addition of

carbonylmetalates to the triangular faces of tetranuclear and larger clusters.

39217 (AD-A—058697) **Synthesis and properties of several new molecular conductors. Technical report.** Brown, D.B.; Wrobleski, J.T. (Vermont Univ., Burlington (USA). Dept. of Chemistry). 10 Sep 1978. Contract N00014-75-C-0756. 12p. NTIS PC A02/MF A01.

Several d8 metal complexes with columnar structures have been prepared using diaminoglyoxime, rubeanic acid, dithiooxalate, and dimethylglyoxime as ligands. These compounds are susceptible to partial oxidation using a variety of electron acceptors such as iodine and quinone. Upon oxidation, the electrical conductivities of these materials increase by as much as eleven orders of magnitude. The role of intermolecular association in the preparation of an excitonic superconductor is discussed. (Author)

39218 (AD-A—059447) **Experimental measurement of the rate of the reaction O(3p) + H2(v = 0) yields OH(v = 0) + H at T = 296°K. Interim report.** Light, G.C. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 14 Aug 1978. Contract F04701-77-C-0078. 35p. NTIS PC A03/MF A01.

Measurement of the rate of the reaction O(3P) + H2(v = 0) yields OH(v = 0) + H is reported. The result is based on data for the absolute density of OH(V = 0) obtained from laser-induced fluorescence measurements in the (0-0) band of the OH system. The densities of oxygen and nitrogen atoms were varied by changing the density of NO which is consumed in the reaction: N + NO yields O + N_2. It was found that K(1) (296 K) = (5.5 + or - 2.9)(million), cc/mole-sec. It was found that the addition of N2 or CO2 effectively suppressed the excitation of H2(v = 1). Measurements of the density of H2(v = 1) were made by VUV absorption in the Lyman band system of H2. All of the reports of low temperature measurements and some recent theoretical calculations for k(1) are discussed. The present result confirms and extends the growing evidence for significant curvature in the low temperature end of an Arrhenius plot of k(1)(T).

39219 (AD-A—059503) **Model calculations of the thermochemical properties of gaseous metal halides. Interim report.** Hildenbrand, D.L. (SRI International, Menlo Park, CA (USA)). 1977. Contract F44620-73-C-0037. 17p. NTIS PC A02/MF A01.

Two semi-empirical models that have proved useful in estimating the thermochemical properties of gaseous halides are the Rittner electrostatic model and the ionicity-corrected Birge-Sponer extrapolation. These two models, their limitations and their areas of applicability are reviewed so that their potential utility in estimating missing thermochemical data can be assessed realistically. A comparison of results of the gaseous II A metal mono- and dihalides, where thermochemical and molecular constant data are relatively complete, shows that the electrostatic model yields dissociation energies with an accuracy of 10 kcal/mol or better. Application of the electrostatic model to the scandium-group and lanthanide halides is also discussed. There is considerable uncertainty about the nature of the overlap repulsion contribution for the polyatomic halides, but an empirically selected repulsion parameter seems to give satisfactory results. For diatomic molecules, the application of an ionicity correction to the linear Birge-Sponer value generally yields dissociation energies which are accurate to within ten percent or better, but the results are sensitive to the quality of the spectroscopic constants used in the evaluation. When used properly, the two models can be very helpful in providing reliable estimates of thermochemical properties. (Author)

39220 (AED-Conf—78-150-004) **Bumnentagung 1978.** (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). 1978. 84p. (In German). (CONF-7805133—). Dep. NTIS (US Sales Only), PC A05/MF A01.

From 77. meeting of the deutsche bunsengesellschaft fuer physikalische gesellschaft; Konstanz, F.R. Germany (4 May 1978).

Individual paper are indexed separately.

39221 (LA—7602-MS) **Stability of the lanthanide hydrides.** Carstens, D.H.W. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

A review of the unclassified literature is presented that tabulates the reported equilibrium pressure data of the lanthanide diprotides and dideuterides in the form log P(torr) = A/T + B. Values of the thermodynamic properties are tabulated and the trend in those data is explained by several semiempirical formulas. The isotope shifts are calculated by two independent means. For any lanthanide metal, the heat of formation of the dihydride is about 1.5 kcal/mole more negative than the dideuteride, which, in turn, is about 0.5 kcal/mole more negative than the dititride. These values agree well with the experimental values. 4 figures, 2 tables.

39222 (LBL—8975, pp 22.) **Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy.** Reucroft, P.J. (Univ. of Kentucky, Lexington). Feb 1979.

In Heterogeneous catalysis research meeting.

39223 (LBL—8975, pp 27.-28.) **Catalytic reactions on well characterized surfaces by ac techniques.** Strozier, J.A. (Brookhaven National Lab., Upton, NY). Feb 1979.

In Heterogeneous catalysis research meeting.

39224 (LBL—8975, pp 29.-30.) **ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions.** Freed, J.H. (Cornell Univ., Ithaca, NY). Feb 1979.

In Heterogeneous catalysis research meeting.

39225 (LBL—8975, pp 42.-44.) **Analysis of chemistry at ionically bonded surfaces by electron stimulated desorption(a).** Knotek, M.L.; Feibelman, P.J. (Sandia Labs., Albuquerque, NM). Feb 1979.

In Heterogeneous catalysis research meeting.

39226 (LBL—8975, pp 49.-51.) **Properties of supported metal catalysts.** Butt, J.B.; Burwell, R.L. Jr.; Cohen, J.B. (Northwestern Univ., Evanston, IL). Feb 1979.

In Heterogeneous catalysis research meeting.

39227 (LBL—8975, pp 55.-57.) **Supported catalysts: synthesis and characterization.** Turkevich, J. (Princeton Univ., NJ). Feb 1979.

In Heterogeneous catalysis research meeting.

39228 (LBL—8975, pp 58.-59) **Theoretical studies of the electronic structure and bonding properties of surfaces.** Painter, G.S. (Oak Ridge National, Lab., TN). Feb 1979.

In Heterogeneous catalysis research meeting.

39229 (LBL—8975, pp 60.-61.) **Theoretical studies of chemisorption on transition metal surfaces: interaction of hydrogen with titanium.** Whitten, J.L.; Doll, J.D. (State Univ. of New York, Stony Brook). Feb 1979.

In Heterogeneous catalysis research meeting.

39230 (LBL—8975, pp 67.-69.) **Physical and catalytic properties of oxides.** Wirtz, G.P. (Univ. of Illinois, Urbana). Feb 1979.

In Heterogeneous catalysis research meeting.

39231 (LBL—8975, pp 73.-74.) **Heterogeneous catalysis and surface chemistry.** Gerstein, B.C. (Iowa State Univ., Ames). Feb 1979.

In Heterogeneous catalysis research meeting.

39232 **Desorption kinetics of one- and two-step mechanisms.** Steinbruechel, C. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Vac. Sci. Technol.;* **16**: No. 2, 547(Mar 1979).

Desoption kinetics may be described alternatively as a one-step or two-step process. Two-step kinetics can be well fitted over the entire coverage range by a one-step expression where the activation energy is a linear function of coverage. (AIP)

39233 **AES investigation of the chemical structure of silicon oxynitride films.** Madden, H.H.; Holloway, P.H. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Vac. Sci. Technol.;* **16**: No. 2, 618-621(Mar 1979).

The silicon-L/sub 2,3/VV, nitrogen-KVV, and oxygen-KVV Auger signals have been measured for a series of chemical-vapor-deposited silicon nitride films in which the oxygen content varied from 2 to 67 at. %. Uncorrected derivative spectra and background-corrected, loss-deconvoluted integral lines for silicon nitride films, for clean Si, and for SiO_2 were compared. The silicon spectra indicate that a high-energy Si-L/sub 2,3/VV feature from the nitride, previously identified with elementally bound Si, actually indicates an oxygen impurity. The N-KVV lineshape is found to be insensitive to oxygen incorporation while the three-peaked oxygen line becomes broader with increasing oxygen content. The valence-electron distribution width in the nitride is more than twice that of the distribution in elemental Si, but the width does not change appreciably with changing oxygen content. These Auger data indicate that oxygen incorporation into silicon nitride results in the formation of oxynitrides for $<$ or $\approx$ 200 ppm of oxygen in the reactor. Beyond this concentration, silicon oxide is largely formed.

39234 **Heat of vaporization spectrometer.** Edwards, D. Jr. (Brookhaven National Laboratory, Upton, New York 11973). *J. Vac. Sci. Technol.;* **16**: No. 2, 695-697(Mar 1979).

Multilayer desorption measurements of various substances adsorbed on a stainless-steel substrate are found to exhibit desorption profiles consistent with a zeroth-order desorption model. The singleness of the desorption transients together with their narrow peak widths makes the technique ideally suited for a heat of vaporization spectrometer for either substance analysis or identification.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 38064, 38312, 38313, 38314, 38315, 39217, 39226, 39231, 39652, 39805

39235 (BETC—5603-5) **Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977—September 1978.** McCormick, C.L.; Neidlinger, H.H.; Hester, R.D.; Wildman, G.C. (University of Southern Mississippi, Hattiesburg (USA). Dept. of Polymer Science). 1 Dec 1978. Contract EF-77-S-05-5603. 131p. Dep. NTIS, PC A07/MF A01.

During the first year of this study, synthetic polymers have been carefully prepared as models of known composition and measurable molecular weight, molecular weight distribution, ionic charge density, and branching. Major efforts have been centered on random copolymers of acrylamide with sodium acrylate and on graft copolymers of acrylamide with well characterized polysaccharides such as dextran and amylose. Additionally, random copolymers of poly(acrylamide-co-sodium acrylate) have been prepared by controlled hydrolysis of polyacrylamide homopolymer. The synthesized laboratory samples as well as selected commercial samples have been extensively characterized. Solution rheological studies have been initiated to investigate the interrelationships between solution behavior and hydrodynamic volume. For example, relationships between molecular structure and solution properties under more ideal conditions have been rather rigorously developed in theory. Intrinsic viscosities of synthesized model polymers and representative commercial samples have been obtained utilizing the Huggins equation, Kraemer equation, and Schulz—Blaschke equation. Effects of mixing conditions and aging effects as well as solvent, electrolyte, pH, and temperature dependence on intrinsic viscosity have been measured. Polymer solution degradation studies during the first year have been directed towarddeveloping quantitative assessments of fluid shear stresses and their effects on primary and secondary bond dissociations during flow of polymer containing fluids through porous media. Laboratory evidence seems to indicate that apparent "shear degradation" observed for a number of polymers in aqueous solutions is largely a result of secondary bond dissociation rather than primary bond cleavage. This phenomenon is reversible and highly time and concentration dependent. Mobility control loss, during polymer flooding, may be largely due to adsorption, flocculation, and excluded volume effects.

39236 (BETC—5603-6) **Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978—December 31, 1979.** Wildman, G.C.; Neidlinger, H.H.; McCormick, C.L.; Hester, R.D. (University of Southern Mississippi, Hattiesburg (USA). Dept. of Polymer Science). 1978. Contract EF-77-S-05-5603. 45p. Dep. NTIS, PC A03/MF A01.

Two homopolyacrylamides, with intrinsic viscosities of 4.85 and 9.48 in water, were synthesized for hydrolysis studies. Samples with degrees of hydrolysis ranging from 29 to 77% have been prepared from these two homopolymers. Additional poly(dextran-g-acrylamide) samples have been prepared via the ceric ion technique. A maximum of 71% acrylamide has been achieved in the copolymers. Additional work on the solution properties of polyacrylamide-type polymers in the low shear rate region (0 to 1000 sec $^{-1}$) has been completed. The theoretical models for dilute polymer solutions of Bueche and of Graessley have been utilized to analyze the rheological data from four commercial partially hydrolyzed polyacrylamides. Flow curves of aqueous solutions of Dow's Pusher/sup R/ 500 and Allied Colloid's Alco/sup R/ 800, Alco/sup R/ 1000, and Alco/sup R/ 1200 were measured at 3000, 1500, and 750 ppM in 1.5% Na_2SO_4 solution. All flow curves were measured at 30°C. The zero shear viscosities and molecular response times were calculated from these data using Bueche's analysis and Graessley's analysis and are summarized. Results from the Bueche analysis give higher values for the zero shear viscosity when compared to results from the Graessley analysis, but lower values for the molecular response time. However, the Bueche parameters are linearly correlated with the Graessleyparameters. More precise data are needed in the very low shear rate range to determine which model, Bueche's or Graessley's, is most reliable in predicting the rheological properties of dilute polymer solutions at very low rates of fluid shear.

39237 (LA—7542) **High-resolution spectroscopy measurements of the $^{12}CF_4$ $\nu_2 + \nu_4$ band at 9 μm.** Begley, R.F.; Radziemski, L.J.; Nereson, N.G.; Flicker, H.; Reisfeld, M.J. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Using a piezoelectric-translator-tuned cw CO_2 laser and a diode laser operating at 9 μm, many high-resolution spectra of the $\nu_2 + \nu_4$ band of $^{12}CF_4$ have been taken. Locations of absorption features within a few megahertz of several CO_2 lines used to pump a $^{12}CF_4$ 16-μm laser have been identified. Absorption coefficients of $^{12}CF_4$ under cooled conditions have been measured within the CO_2 low-pressure gain lines. Detailed, consecutive diode-laser measurements across the P, Q, and R branches of the $\nu_2 + \nu_4$ band, taken at low temperature to eliminate hot bands, have led to tentative frequency assignments of the difficult spectrum of this molecule. Details of the frequency-assignment work will be presented in a later publication.

39238 (LBL—8975) **Heterogeneous catalysis research meeting.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979. Contract W-7405-ENG-48. 95p. Dep. NTIS, PC A05/MF A01.

This report summarizes an informal meeting on the current status of heterogeneous catalysis research sponsored by DOE. The meeting was held primarily to acquaint each participant with the scope of research being and to focus attention on the needed but unanswered technical and scientific questions. Each principal investigator presented a brief review of the fundamental heterogeneous catalysis research in progress at his laboratory. A set of discussion questions pertinent to appropriate directions for future research was considered. A summary is given of the discussions resulting. In addition project summaries which outline the research objectives and scope, describe the research effort, tabulate progress to date, and outline future research strategies are presented for each laboratory. Each project summary was indexed for entry into the data base. (JSR)

39239 (LBL—8975, pp 23.-24.) **Chemical poisoning in heterogeneously catalyzed reactions.** Bernasek, S.L. (Princeton Univ., NJ). Feb 1979.

In Heterogeneous catalysis research meeting.

39240 (LBL—8975, pp 33.) **Diffusion of polyaromatics in catalyst supports.** Massoth, F.E. (Univ. of Utah, Salt Lake City). Feb 1979.

In Heterogeneous catalysis research meeting.

39241 (LBL—8975, pp 40.-41.) **Chemical information in Auger spectroscopy.** Rye, R.R.; Houston, J.E.; Jennison, D.R. (Sandia Labs., Albuquerque, NM). Feb 1979.

In Heterogeneous catalysis research meeting.

39242 (LBL—8975, pp 75.-76.) **Influence of f-electron configuration on catalytic properties of lanthanide oxides.** Rosynek, M.P. (Texas A and M Univ., College Station). Feb 1979.

In Heterogeneous catalysis research meeting.

39243 **Time dependence of triplet—singlet excitation transfer from compact poly rA to bound dye at 77 k.** Pearlstein, R.M.; Nostrand, F.V.; Nairn, J.A. (Oak Ridge National Lab., TN). *Biophys. J.*; **26**: No. 1, 61-71(Apr 1979).

The nonexponential phosphorescence decay of a highly folded form of polyriboadenylic acid (poly rA) with noncovalently bound dye is explained by a novel application of a well-known theory of electronic excitation transfer based on the Forster mechanism. This theory, originally used to describe singlet-singlet energy transfer from donor molecules to an acceptor in a solution, is here applied to the transfer of triplet excitation from the adenine (in poly rA) to the singlet manifold of either of the bound dyes, ethidium bromide or proflavine. New experimental data are presented that allow straight-forward theoretical interpretation. These data fit the form predicted by the theory, U(t)exp(-Bt/sup 1/2/), where U(t) is the decay of the poly rA phosphorescence in the absence of dye, for a range of relative concentrations of either dye. The self-consistency of these theoretical fits is demonstrated by the proportionality of B to the square root of the Forster triplet-singlet overlap integrals for transfer from poly rA to each of the dyes, as demanded by the theory. From these self-consistent values of B, the theory enables one to deduce the mean packing density of nucleotides in this folded poly rA, which we estimate to be ~ 1 nm^{-3}. We conclude that some variation of the method described here may be useful for deducing packing densities of nucleotides in other compact nucleic acid structures.

39244 (UR—3490-1573) **Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3'-5')guanosine.** Sakore, T.D.; Reddy, B.S.; Sobell, H.M. (Rochester Univ., NY (USA)). 1979. Contract EY-76-C-02-3490. 36p. Dep. NTIS, PC A03/MF A01.

9-Aminoacridine forms a crystalline complex with the dinucleoside monophosphate, 5-iodocytidylyl(3'-5')guanosine (iodoCpG). These crystals are monoclinic, space group $P2_1$, with a = 13.98 A, b = 30.58 A, c = 22.47 A and β = 113.9. The structure has been solved to atomic resolution by Patterson and Fourier methods, and refined by a combination of Fourier and sum function Fourier methods. The asymmetric unit contains four 9-aminoacridine molecules, four iodoCpG molecules and 21 water molecules, a total of 245 atoms. 9-Aminoacridine demonstrates two different intercalative binding modes and, along with these, two slightly different intercalative geometries in this model system. The first of these is very nearly symmetric, the 9-amino- group lying in the narrow groove of the intercalated base-paired nucleotide structure. The second shows grossly asymmetric binding to the dinucleotide, the 9-amino- group lying in the wide groove of the structure. Associated with these two different intercalative binding modes is a difference in geometries in the structures. Although both structures demonstrate C3' endo (3'-5') C2' endo mixed sugar puckering patterns, with corresponding twist angles between base-pairs of about 10°, they differ in the magnitude of the helical screw axis dislocation accompanying intercalation. In the pseudosymmetric intercalative structure, this value is about +0.5 A, whereas in the asymmetric intercalative structure this value is about +2.7 A. These conformational differences can be best described as a sliding of base-pairs on the intercalated acridine molecule.

39245 (UR—3490-1574) **Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine.** Reddy, B.S.; Seshadri, T.P.; Sakore, T.D.; Sobell, H.M. (Rochester Univ., NY (USA). Dept. of Chemistry; Rochester Univ., NY (USA). School of Medicine and Dentistry). 1979. Contract EY-76-C-02-3490. 38p. Dep. NTIS, PC A03/MF A01.

Acridine orange and proflavine form complexes with the dinucleoside monophosphate, 5-iodocytidylyl(3'-5') guanosine (iodoCpG). The acridine orange-iodoCpG crystals are monoclinic, space group $P2_1$, with unit cell dimensions a = 14.36 A, b = 19.64 A, c = 20.67 A, β = 102.5. The proflavine-iodoCpG crystals are monoclinic, space group C2, with unit cell dimensions a = 32.14 A, b = 22.23 A, c = 18.42 A, β = 123.3. Both structures have been solved to atomic resolution by Patterson and Fourier methods, and refined by full matrix least squares. Acridine orange forms an intercalative structure with iodoCpG but the acridine nucleus lies asymmetrically in the intercalation site. This asymmetric intercalation is accompanied by a sliding of base-pairs upon the acridine nucleus. Base-pairs above and below the drug are separated by about 6.8 A and are twisted about 10°. Proflavine demonstrates symmetric intercalation with iodoCpG. Hydrogen bonds connect amino- groups on proflavine with phosphate oxygen atoms on the dinucleotide. Base-pairs above and below the intercalative proflavine molecule are twisted about 36°. The altered magnitude of this angular twist reflects the sugar puckering pattern that is observed. We propose a proflavine-DNA and an acridine orange-DNA binding model. We will describe these models in detail in this paper.

39246 **Catalytic hydrogenation process.** Reid, R.E.; Zang, H.K. (to Texaco Inc.). US Patent 4,137,267. 30 Jan 1979. Filed date 22 Feb 1977. 6p.

Alkyl 1,3-diaminopropanes can be prepared by reacting and alkyl aminopropionitrile in the liquid phase in an organic solvent with hydrogen and ammonia and using a hydrogenation catalyst. The preferred catalysts appear to be nickel and palladium and particularly, a nickel on kieselguhr promoted with zirconium or palladium on carbon catalysts. The reaction is to be conducted over a rising temperature range of about 180°-260°F and at pressures of about 200-1000 psig to prevent complete evaporation of the solvent prior to the completion of the reaction.

ELECTROCHEMISTRY

39247 (NTIS/PS—78/1033) **Electrochemical reactions at surfaces. Volume 1, 1964-1975 (a bibliography with abstracts). Report for 1964—75.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 173p. NTIS PC N01/MF N01.

The studies cover electrode processes in aqueous solutions, although some molten salt processes are included. The research covers battery electrode reactions, catalyst reactions, electrochemical corrosion studies, theoretical analysis, fuel cell electrode reactions, electrical double layer, chemisorption, and measurement techniques. (This updated bibliography contains 169 abstracts, none of which are new entries to the previous edition.)

39248 (NTIS/PS—78/1034) **Electrochemical reactions at surfaces. volume 2, 1976—September, 1978 (a bibliography with abstracts). Report for 1976—September 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 107p.

This bibliography covers electrode processes in aqueous solutions. The citations discuss battery electrode reactions, fuel cell reactions, electrochemical corrosion studies, catalyst reactions, chemisorption, theoretical analysis, electrical double layer, and measurement techniques. Also included are some molten salt processes. (This updated bibliography contains 103 abstracts, 35 of which are new entries to the previous edition.)

39249 **Courage for a market economy energy policy.** Lantzke, U. *Z. Energiewirtsch.;* No. 1, 54-59(1977). (In German).

Following a description of the international problem situation of the energy supply and its interdependences, the importance and tasks of the International Energy Agency (IEA) are explained. The main aim of this organization, to which 19 industrial countries in Europe, North America and the Pacific belong is cooperation in the field of energy policy to a greater depth. The dialogue with oil-extraction countries is particularly important. Difficulties during voting are dindicated, and problems yet to be solved are discussed briefly.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 39253

39250 **Laser photodetachment of electrons from O_2^- in nonpolar liquids).** Sowada, U.; Holroyd, R.A. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *J. Chem. Phys.;* 70: No. 8, 3586-3591(15 Apr 1979).

The wavelength dependence of the photodetachment cross section of electrons from O_2^- in liquid tetramethylsilane, 2,2-dimethylpropane, 2,2,4-trimethylpentane and argon was measured from the conductivity change induced by a short laser pulse. The O_2^- was generated by exposing a solution of O_2 to a pulse of 2 MeV x rays just prior to the laser pulse. Comparison with gas phase results from the literature shows that the threshold law is the same in the two phases, and that the size of the cross section is similar at comparable excess energies. However, the thresholds are shifted from the infrared in the gas phase to the visible region in solution. The observed values are: E/sub t/h=2.08, 2.02, 2.55 eV in tetramethylsilane, 2,2-dimethylpropane, and 2,2,4-trimethylpentane at 296 K, respectively, and 2.32 eV in tetramethylsilane at 200 K. The major energy term causing this shift is the solvation energy of O_2^-. If this is described by Born's equation the effective radius of O_2^- is 1.54 +- 0.02 A in the hydrocarbons and tetramethylsilane. The threshold observed in argon is 2.43 eV which is attributed to photodetachment from O_4^-. From the observed threshold law it is concluded that the density of states of the conduction band in these liquids has the same (parabolic) shape as in the gas phase. This technique is shown to be useful to measure rate constants for electron transfer in solution.

39251 **Laser induced fluorescence studies of the reactions of barium (^1S, ^3D) and strontium (^1S, ^3P) with halogenated methanes.** Solarz, R.W.; Johnson, S.A. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Chem. Phys.;* 70: No. 8, 3592-3599(15 Apr 1979).

Laser excitation of barium and strontium atoms followed by laser induced fluorescence detection of chemical reaction products is used to study the dynamics of reactive collisions of these reagents with halogenated methanes. We report state-to-state distributions in reactions of ground state Ba and ground state Sr, ($^1S_0$), and laser excited Ba($^3D_2$ and $^3D_1$) and Sr($^3P_1$) with CH_3X, CF_3X (X=F,Cl,Br), CCl_3F, and CCl_4. We demonstrate that in certain cases reaction can be initiated by electronic excitation of the atomic reagent. We also show that the vibrational energy distribution of the diatomic alkaline earth halide product is in each case determined principally by the nature of the reacting halogenated methane irrespective of the surface on which the reaction is initiated. Measurements of the relative reactivity of different spin orbit states of excited barium are also presented.

RADIATION CHEMISTRY

39252 (NDRL—1960) **Quarterly report, October 1, 1978—December 31, 1978.** (Notre Dame Univ., IN (USA). Radiation Lab.). 17

Jan 1979. Contract EY-76-C-02-0038. 47p. Dep. NTIS, PC A03/MF A01.

Investigations in progress include: some aspects of electron scavenging reactrons; solvated elections; application of Eyring theory to the time of formation of solvated electrons; electrons in ice; free-ion yield in liquid argon under alpha-irradiation; electron thermalization in gases; field-dependent transport coefficients; structure of the t-butyl radical; interaction of metastable neon with water; multiphoton ionization spectroscopy of trimethyl amine; studies of radical ions of polyenes by optical pulse radiolysis; and electron and photoelectron transfer reactions in Rb-THF solutions. Abstracts of reports published this quarter are included. (LK)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 38225, 39201

39253 (CONF-790415—21) **Photochemistry of the actinides.** Toth, L.M.; Bell, J.T.; Friedman, H.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

It has been found that all three major actinides have a useful variety of photochemical reactions which could be used to achieve a separations process that requires fewer reagents. Several features merit enumerating: (1) Laser photochemistry is not now as uniquely important in fuel reprocessing as it is in isotopic enrichment. The photochemistry can be successfully accomplished with conventional light sources. (2) The easiest place to apply photo-reprocessing is on the three actinides U, Pu, and Np. The solutions are potentially cleaner and more amenable to photoreactions. (3) Organic-phase photoreactions are probably not worth much attention because of the troublesome solvent redox chemistry associated with the photochemical reaction. (4) Upstream process treatment on the raffinate (dissolver solution) may never be too attractive since the radiation intensity precludes the usage of many optical materials and the nature of the solution is such that light transmission into it might be totally impossible.

39254 (LBL—8548) **Chemical reduction of refractory oxides by atomic hydrogen.** Dooley, D.; Balooch, M.; Olander, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 6p. (CONF-781105—102). Dep. NTIS, PC A02/MF A01.

From ANS meeting; Washington, DC, USA (12 Nov 1978).

The chemical reduction of UO_2 and Al_2O_3 by atomic hydrogen was studied. Results of the UO_2/H investigation indicates that reduction of UO_2 by atomic hydrogen proceeds by the production of water vapor and hypostoichiometric urania. Water vapor and aluminum metal are formed in the Al_2O_3/H system. The relative ease which UO_2 is reduced by atomic hydrogen compared with Al_2O_3 is due to two factors. The first is related to the thermochemistry of the reactions. The second factor which favors efficient reduction of UO_2 but not of Al_2O_3 is the oxygen diffusivity. (LK)

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 38258, 39465

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 38174, 38311

39255 (UCRL—82181) **Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16.** Parks, D.J.; Alvares, N.J.; Beason, D.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Mar 1979. Contract W-7405-ENG-48. 27p. (CONF-790434—2). Dep. NTIS, PC A03/MF A01.

From Spring meeting on western states section, and the Combustion Institute; Provo, UT, USA (23 Apr 1979).

An acoustically tuned flame tube was used to measure fundamental flame speed and flammability envelopes of premixed propane/air and methane/air that contain minute amounts of CF_3Br. The flat propagation boundaries produced by this tube allow one to measure fundamental flame speed directly without having to make complicated velocity adjustments because of irregular flame shape. Measurement data show flame speed decreases exponentially with the concentration of CF_3Br regardless of the equivalence ratio, and more CF_3Br is needed to make fuel-rich mixtures inert than to make fuel-lean mixtures inert. Consequently, one can attain significantly lower flame speed on the fuel-rich side of the flammability envelope. The implications of these data for gross extinguishment mechanisms indicate CF_3Br combines with free hydrogen radicals in competition with oxygen to interfere with chain-branching propagation. 14 figures.

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 38734, 38745, 38748, 39035, 39144, 39958

39256 (ANL—78-65(Pt.2), pp 127-137) **Design, construction, and operation of a new radon transfer system.** Holtzman, R.B.; Markun, F.; Miranda, J.E. Jr. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

A new radon transfer line was constructed from a design modified from the earlier one of Lucas. A roller-type peristaltic transfer pump and a pressure-sensitive transducer were substituted for the previously used equipment. The electrical and electronic equipment and operating switches are consolidated in a single control panel. Black or amber pure gum, latex dipped tubing were shown to have a minimum memory effect for radon, and a silicone tubing also appears to be suitable. The precision of measurement was about 2.7% (S.D.), based on eight replicate measurements with a single standard solution of radium. During the course of these tests, it was found that part of the variability was due to leakage of radon from the flask that contained the radium.

39257 **After -burner for flue gas from solid, liquid or gaseous materials.** Kroll, W. (to Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,449,979/B/. 14 Jul 1977. 5p. (In German).

An after burner is introduced for a wood-or paper-fired furnace, which sits in the flow of the flue gases and makes possible a subsequent combustion of these flue gases in the incadescent zone. The transversely arranged elements are made as a grid and permit separation of dust-like ash particles from the flue gas.

39258 (LA-UR—79-332) **Ceramic heat pipes for high temperature heat removal.** Keddy, E.S.; Ranken, W.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 17p. (CONF-7808101—1). Dep. NTIS, PC A02/MF A01.

From 18. AICHe-ASME national heat transfer conference; San Diego, CA, USA (5 Aug 1978).

Difficulties in finding metal or protected metal components that exhibit both strength and corrosion resistance at high temperature have severely restricted the application of effective heat recovery techniques to process heat furnaces. A potential method of overcoming this restriction is to use heat pipes fabricated from ceramic materials to construct counterflow recuperators. A development program has been initiated to demonstrate the technical and eventually the economical feasibility of ceramic heat pipes and ceramic heat pipe recuperators. The prime candidate for heat pipe construction is SiC. Closed-end tubes of this material have been prepared by chemical vapor deposition (CVD). These tubes were lined internally with tungsten by a subsequent CVD operation, partially filled with sodium, and sealed by brazing a tungsten lined SiC plug into the open-end with a palladium—cobalt alloy. Heat pipes constructed in this manner have been successfully operated in vacuum at temperatures of 1225°K and in air at a temperature of 1125°K. The heat source used initially for the air testing was an induction heated metallic sleeve in thermal contact with the test unit. Subsequent testing has shown that a silicon carbide heat pipe can be successfully operated with natural gas burners providing the input heat. Methods of fabricating and testing these devices are described.

39259 (ORNL/TM—6855) **Measurement error in pressure-decay leak testing.** Robinson, J.N. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

The effect of measurement error in presssure-decay leak testing is considered, and examples are presented to demonstrate how it can be properly accomodated in analyzing data from such tests. Suggestions for more effective specification and conduct of leak tests are presented.

39260 (SAND—79-0329) **Multiple application coded switch development report.** Bernal, E.L.; Kestly, J.D. (Sandia Labs., Albuquer-

que, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 44p. Dep. NTIS, PC A03/MF A01.

The development of the Multiple Application Coded Switch (MACS) and its related controller are documented; the functional and electrical characteristics are described; the interface requirements defined, and a troubleshooting guide provided. The system was designed for the Safe Secure Trailer System used for secure transportation of nuclear material.

39261 (UCID—18160) **Structural response of VRO and FKM propellants during a rocket motor implosion.** Werne, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The accident scenario assumes that a solid propellant rocket motor is ignited and begins to burn normally. A crack develops in the propellant grain near the rear of the motor (near the nozzle) and at the center bore. The crack propagates diagonally toward the rear and to the interface between the propellant grain and the motor case. The crack then propagates along at the interface between the grain and case causing debonding to occur. The driving force for the crack is the pressure applied to the cracked surface of the propellant caused by burning of that surface. At a certain point in time a destruct mechanism causes the bore pressure to be relieved. However, the burning propellant at the interface between the case and grain causes the pressure to remain high along that interface. This results in a thick cylinder of propellant with a high external pressure applied to it and little or no internal pressure. Only inertia and the strength of the propellant will resist the implosion of the cylindrical propellant grain. The scenario depicted is cast into the form of an analytical model which can then be used to compare the response of the VRO and FKM propellants.

39262 (UCID—18170) **Morey mill retrofit.** Zuppan, A.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

The retrofit of a Morey bridge profile contouring mill at LLL is described. There were three parts of this retrofit effort. First, the old, troublesome hard-wired numerical control was replaced with a new computerized control system. Second, the old servo-drive system with its complex of gears and motors was rebuilt with new motors and fewer gears, and a special technique and procedure was used to adjust the servo drive so it responded properly. Third, the old feedback resolvers were replaced with new, maintenance-free brushless resolvers. The final result was a mill that is accurate, reliable, dependable, and easy to use. The retrofit also gave the system increased capabilities such as editing, pattern storage, cutter compensation, ability to cut in metric or inch measurements, and a Programmable Application Logic (PAL) program. This particular Morey milling machine is used in the LLL machine shop to machine high accuracy metal and plastic parts for all the laboratory programs. Parts milled include special grids for the laser program, test specimens of special materials, templates for machining parts on template lathes, name plates for retirements and service awards and parts for the weapons program.

39263 (Y—2180) **Interfacing the linear motor slide drive to a precision machine tool.** Barkman, W.E.; Brown, R.J.; Gerth, H.L.; Green, W.L. (Oak Ridge Y-12 Plant, TN (USA)). Apr 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

A linear-motor slide-drive system has been used to replace the mechanical gear train on a large-component diamond-turning lathe. Inaccuracies in the previous lead-screw drive system resulted in cyclic errors of 0.25 to 2.5 μm (10 to 100 μ in.), which corresponded to the pitch of the screw. These cyclic errors have been eliminated, and the machine is presently being used to successfully fabricate reflective metal optics.

39264 **Dowel pin.** Wojcik, T.A. (to Dept. of Energy). US Patent 4,130,369. 19 Dec 1978. Filed date 27 Sep 1977. 4p.

Two abutting members are locked together by reaming a hole entirely through one member and at least partly through the other, machining a circular groove in each through hole just below the surface of the member, press fitting a dowel pin having a thin wall extension on at least one end thereof into the hole in both members, a thin wall extension extending into each through hole, crimping or snapping the thin wall extension into the grooves to positively lock the dowel pin in place and, if necessary, tack welding the end of the thin-wall extention in place.

39265 **Interferometric correction system for a numerically controlled machine.** Burleson, R.R. (to Dept. of Energy). US Patent 4,128,794. 5 Dec 1978. Filed date 11 Oct 1977. 10p.

An interferometric correction system for a numerically controlled machine is provided to improve the positioning accuracy of a machine tool, for example, for a high-precision numerically controlled machine. A laser interferometer feedback system is used to monitor the positioning of the machine tool which is being moved by command pulses to a positioning system to position the tool. The correction system compares the commanded position as indicated by a command pulse train applied to the positioning system with the actual position of the tool as monitored by the laser interferometer. If the tool position lags the command position by a preselected error, additional pulses are added to the pulse train applied to the positioning system to advance the tool closer to the commanded position, thereby reducing the lag error. If the actual tool position is leading in comparison to the commanded position, pulses are deleted from the pulse train where the advance error exceeds the preselected error magnitude to correct the position error of the tool relative to the commanded position.

39266 **Tool for cutting insulation from electrical cables.** Harless, C.E.; Taylor, W.G. (to Dept. of Energy). US Patent 4,127,937. 5 Dec 1978. Filed date 11 Jan 1978. 6p.

This invention is an efficient hand tool for precisely slitting the sheath of insulation on an electrical cable, e.g., a cable two inches in diameter, in a manner facilitating subsequent peeling or stripping of the insulation. The tool includes a rigid frame which is slidably fitted on an end section of the cable. The frame carries a rigidly affixed handle and an opposed, elongated blade-and-handle assembly is pivotally supported by a bracket which is slidably mounted on the frame for movement toward and away from the cable, thus providing an adjustment for the depth of cut. The blade-and-handle assembly is mountable to the bracket in two pivotable positions. With the assembly mounted in the first position, the tool is turned about the cable to slit the insulation circumferentially. With the assembly mounted in the second position, the tool is drawn along the cable to slit the insulation axially. When cut both circumferentially and axially, the insulation can easily be peeled from the cable.

39267 **Comparison of conjugate cyles of power and refrigerating installations.** Chikovani, V.V.; Evseev, V.S. *Izv. Vyssh. Uchebn. Zaved., Energ.;* 93-99(Aug 1978). (In Russian).

Using the criteria of maximum energy efficiency and minimum weight and size characteristics of radiators, single- and two-loop power and refrigerating plants (PRP), realizing mutually related Brayton cycles between three sources of heat, and generating mechanical energy and cold at the same time, are compared. It is shown that the plants in question do not differ in practice as regards their energy efficiency. As regards weight and size characteristics as well as structural reliability, single-loop PRP are superior to two-loop ones.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 38621, 38831, 38832, 38958, 38970, 39944, 39955

39268 (ANL/FPP/TM—118) **Square function analysis of the Inductor-Converter Bridge.** Ehsani, M.; Kustom, R.L. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 38p. Dep. NTIS, PC A03/MF A01.

The transfer of energy between two superconducting coils can be controlled with an Inductor-Converter Bridge (ICB) by changing the relative timing between the storage side bridge and the load side bridge. The average voltages on the coils have been previously derived as a function of relative timing between the two halves of the bridges and the relative currents in the two coils using a one-line, harmonic current source representation of each coil and its bridge network. Since the coil current in each of the ICB phases appears as bipolar rectangular pulses, an analysis based on unit step functions has been developed. The unit step function analysis leads to simple polynomial expressions relating the average coil voltages to relative timing. The new derivations are shown to have the same harmonic representation as previously developed. The polynomial expressions are more compatible to microprocessor control than are the harmonic function expressions.

39269 (BNL—50961) **Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976—September 30, 1977.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1978. Contract EY-76-C-02-0016. 34p. Dep. NTIS, PC A03/MF A01.

The objectives of this project are to develop suitable and economical conductors for fusion magnets, in particular, to develop methods for improving the mechanical properties of Nb_3Sn conductors. This includes the measurement and study of degradation mechanisms of Nb_3Sn conductors under mechanical strain. The investigation of degradation in the superconducting properties of Nb_3Sn conductors under mechanical stresses for FY 1977 can be divided into the following areas: (1) monofilamentary Nb_3Sn wires, (2) multifilamentary Nb_3Sn wires and conductors, (3) effects of additives to Nb_3Sn, (4) mechanism for degradation, and (5) construction of high field test facilities. Our effort in FY 1977 has been concentrated in the investigation of T/sub c/, J/sub c/ and H/sub c2/ variations

in monofilamentary Nb_3Sn wires. The most important finding in this study is that a Nb_3Sn wire can sustain mechanical strain well beyond 1% if a proper ratio of the matrix to the Nb core was chosen.

39270 (LA—7639-MS) **Losses in superconducting multifilament composites under alternating changing fields.** Turck, B. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

The first part of this report presents a brief review of the losses in superconducting composites in a changing external field. The losses are expressed for a single triangular shaped pulse and for a field varying exponentially with time. The losses are calculated as a function of two important time constants. The first is due to the coupling currents between the filaments, the second is due to the eddy currents induced in the matrix. In the second part of the report, the case of an oscillating sinusoidal field is considered. In particular, in a rapidly varying field, several layers of filaments can be saturated by returning currents. Complete expressions of the losses are provided together with simplified expressions which enable one to calculate the losses in most cases. In the third part, a comparison between several kinds of conductors shows that in some cases the losses are reduced by increasing the twist pitch of the conductor.

39271 (N—78-28354) **Superconducting disc alternator.** Harrowell, R.V. (Central Electricity Generating Board, London (UK)). Aug 1977. 10p. NTIS PC A02/MF A01.

A preliminary study of a superconducting alternator with a rotating disc armature was made. The field winding is a superconducting toroid with diametrically opposite gaps in which the disc armature rotates. The major advantages of such a machine are: (1) the stationary field winding can be easily cooled to 4.2 K, and it can also be supported against torque forces without the difficulties associated with a rotating field winding; (2) the field winding does not produce significant stray magnetic fields; (3) it is an inherently low-cost machine; (4) intermediate shaft bearings can be incorporated, thus permitting scaling up by an increase in machine length; and (5) a 500 MW machine would weigh less than 100 tons. The chief disadvantage of such a generator is the need for high-current, high voltage brushes, and slip rings. Three possible systems of current collection are reviewed. The chances of producing a viable system are good.

39272 **Superconductive winding for an iron core rotor of a dynamoelectric machine.** Carr, W.J. Jr. (to Westinghouse Electric Corp.). US Patent 4,146,804. 27 Mar 1979. Filed date 31 May 1977. 12p.

Iron or other ferromagnetic material is utilized in the rotor core of a dynamoelectric machine having a superconductive field winding. A parallel connection arrangement of the winding in combination with a plurality of current dividing resistance elements provides a sinusoidal distribution of current density across the circumference of the rotor. The magnetic field associated with the sinusoidal current distribution is reduced in critical interior regions of the winding by the demagnetizing field produced by the magnetic poles of the ferromagnetic core, thereby allowing a larger current to flow in the winding without destroying superconductivity. The two fields add in regions exterior to the winding, thereby providing a net increase in the useful external field obtained from a given amount of superconductive material.

39273 **Method and device for monitoring superconducting system.** Nomura, H.; Takahisa, K. (to Agency of Industrial Science and Technology). US Patent 4,140,021. 20 Feb 1979. Priority date 8 Oct 1976, Japan, 22p.

The explosion or destruction of a superconducting system which may occur when an abnormal state arises in any part of the system if allowed to develop into a catastrophic quenching is prevented by providing the system with an acoustic wave detecting device adapted to detect the acoustic waves emitted upon occurrence of the abnormal state, analyze the acoustic wave detected in the form of signals to determine the extent of the abnormal state, foretell stepwise the approach of catastrophic quenching and, on the basis of the data thus obtained, effect proper feedback to the system.

39274 **Adjustable expandable cryogenic piston and ring.** Mazur, P.O.; Pallaver, C.B. (to Dept. of Energy). US Patent Application 912,784. 5 Jun 1978. 14p.

The operation of a reciprocating expansion engine for cryogenic refrigeration is improved by changing the pistons and rings so that the piston can be operated from outside the engine to vary the groove in which the piston ring is located. This causes the ring, which is of a flexible material, to be squeezed so that its contact with the wall is subject to external control. This control may be made manually or it may be made automatically in response to instruments that sense the amount of blow-by of the cryogenic fluid and adjust for an optimum blow-by.

HANDLING EQUIPMENT AND PROCEDURES

39275 (AECL—5807(rev.1)) **Criticality data for $(Pu,U)O_2$ fuel.** Keller, N.A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1978. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The code SU-HAMMER was used to generate criticality data for $(Pu,U)O_2$ fuels for up to 5 wt% PuO_2 in the mixed oxide. The calculational methods were validated against critical experiments.

39276 (AECL—5917) **Validation of the KENO and SU-HAMMER codes for critical solution systems of U-233 and U-235.** Keller, N.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1978. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The codes KENO and SU-HAMMER have been used to calculate critical solution experiments for U-233 and U-235. The codes appear to perform adequately, except for low H/U-233 ratios where SU-HAMMER k-effectives are considerably higher than unity.

SHIPPING CONTAINERS

39277 (NUREG/CR—0589) **Dynamic analysis to establish normal shock and vibration of radioactive material shippng packages. Quarterly progress report, July—September 1978.** Fields, S.R.; Mech, S.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1978. 43p. (HEDL-TME—78-102). NTIS, PC A03/MF A01.

A new calculation sequence was developed to simulate the behavior of the coupler subsystem for the cask-rail car (hammer car) and the lead car in the group it impacts (struck car) during humping operations. Results from this submodel compare well with experimental results for friction draft gears in their active state during impact. Eighteen rail car impact tests were completed and the data being processed. Collection of data on key parameters for the cask-rail car dynamic model was resumed. A data base is being established for the parametric and sensitivity analysis. (DLC)

39278 (REG/G—7.9) **Standard format and content of Part 71 applications for approval of packaging of Type B, large quantity, and fissile radioactive material.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1979. 40p. Nuclear Regulatory Commission, Washington, DC.

Purpose of this regulatory guide is to assist the applicant in preparing an application that demonstrates the adequacy of the package in meeting the regulations. It covers: structural evaluation, thermal evaluation, containment, shielding evaluation, criticality evaluation, operating procedures, and acceptance tests and maintenance program. (DLC)

39279 (SAND—78-1584C) **Environmental impact of accidents involving radioactive material shipping systems.** Yoshimura, H.R.; Pope, R.B.; Huerta, M.; Nilson, R.H. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 19p. (CONF-781109—27). Dep. NTIS, PC A02/MF A01.

From Environmental control symposium; Washington, DC, USA (28 Nov 1978).

Four full-scale spent fuel cask crash tests have been performed, including two head-on truck-barrier impacts (100 and 135 km/h), one railcar-barrier impact (130 km/h), and one locomotive grade crossing impact (130 km/h). Releases to the environment were limited to seepage of about 100 cc of cavity liquid from the cask head in the 135 km/h truck impact test and a slight head seal air leak in the 130 km/h locomotive grade crossing test. These releases were well within the limits specified by the NRC regulations, would have been easily cleaned up, and would have caused little effect on the environment and virtually no risk to the public. To further evaluate cask capability, the crashed spent-fuel rail cask system was fire tested. The cask withstood 90 minutes of a fully engulfing hydrocarbon pool fire while maintaining its structural integrity. At approximately 100 minutes into the fire test, the outer shell of the cask cracked resulting in the partial loss of lead radiation shielding. The failure of the shell was attributed to poor quality control during the original fabrication of the cask in the early 1960's. Present regulatory standards would prevent such occurrences in casks built and licensed today. In addition, the test was much more severe than the qualification criteria specified by present licensing requirements. 4 tables, 13 figures.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 38108

39280 **Raise drill inner yoke bridge.** Dixon, R.L.; Maxsted, M.D.; Kellner, J.M. (to Smith International, Inc.). US Patent 4,142,593. 6 Mar 1979. Filed date 25 Oct 1977. 6p.

A raise drill is disclosed for enlarging a pilot hole into a large diameter hole by disintegrating the earth formations surrounding the pilot hole. The raise drill includes a bit body having a plurality of roller cutters mounted thereon. The bit body is detachable secured to a drive stem to permit removal and replacement of the stem. A shock absorbing element is interconnected between the drive stem and the bit body to enable the bit body to be flexibly mounted on the drive stem. A central yoke is provided to extend around the drive stem and interconnect the saddles of the two innermost cutters. The central yoke functions to distribute the loading of the inboard cutters. The central yoke can also function as a housing for a packing element.

LASERS

REFER ALSO TO CITATION(S) 39218, 39439, 39474

39281 (AD—923260) **RDA ruby laser frequency doubler system. Quarterly progress report no. 3, 24 oct 73-23 jan 74.** Klainer, S.M.; Rusche, R. (Block Engineering, Inc., Cambridge, MA (USA)). Jun 1974. Contract DAAA15-73-C-0183. 10p. NTIS PC A02/MF A01.

The contract is to develop a frequency doubler for ruby laser, using an RDA and RDP crystal. The report, which gives the progress to January 1974, covers the completion of design and fabrication of the temperature controlled RDA crystal mount, as well as investigation into the cause of crystal failures. Modification work done on the field instrument is also described.

39282 (AD-A—057904) **Multi stage q-switched iodine laser. Master's thesis.** Perin, J.M. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1978. 89p. NTIS PC A05/MF A01.

A two stage high energy iodine laser has been constructed using an existing oscillator stage that was modified so as to accept a Pockels cell and associated Brewster window stack for Q-switching. The output of the oscillator stage was then amplified by a second stage consisting of a 2.54 cm quartz lasing tube, 120 cm long and four flashlamps contained in an elliptical reflector. With 1180 Joules applied to the oscillator stage flashlamps, an output energy of 30 millijoules with a repeatability of two percent was achieved. Pulse duration measurements were detector limited. Estimates put the pulse duration at less than 100 ns. Applying 3580 J to the flashlamps of the amplifier stage and using the stated oscillator output resulted in an estimated output energy of 8.2 Joules with similar repeatability and pulse duration to that of the oscillator stage alone. For both stages the output beam profile was found to be gaussian.

39283 (AD-A—058306) **Investigation of group IV-A metal vapor generation and flux behavior. Final report.** Golden, J.A.; Zavitsanos, P.D. (General Electric Co., Philadelphia, PA (USA). Re-Entry and Environmental Systems Div.). May 1978. Contract F29601-76-C-0060. 39p. NTIS PC A03/MF A01.

The gas phase reactions of certain Group IV-A metals with N^2O can give rise to electronically excited metal oxide species which have been considered candidates as active molecules for electronic transition chemical lasers. The objectives of this program were to obtain experimental data on selected Group IV-A metals as they pertain to the properties of the gas phase generation and transfer and also to devise practical schemes for developing a metal vapor generator which may permit an evaluation of their potential as laser pumping sources.

39284 (AD-A—059429) **Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77.** Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). Mar 1978. Contract F19628-75-C-0060. 148p. NTIS PC A07/MF A01.

Several topics are summarized in the areas of laser studies of velocity-dependent collision cross sections continuously-tunable high-pressure CO^2 lasers, multifrequency CO^2 lasers, vibrational energy transfer in summetric top molecules, visible laser-induced chemical reactions, coherent pulse propagation and population inversion using adiabatic rapid passage, high-pressure CO^2 capillary lasers, study of molecular helium, a stacked Blumlein N^2 laser, excimer lasers, water vapor spectroscopy using a tunable SFR laser, two photon spectroscopy in NO, anomalous Zeeman in CO^2 and N^2O, and hyperfine structure in N^2O.

39285 (AD-A—059811) **Advanced laser concepts. Final report.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). May 1978. Contract F29601-76-C-0065. 117p. NTIS PC A06/MF A01.

Studies directed toward the development of a chemically pumped electronic transition laser are described. A small-scale HF/DF laser device was used to study excited state production in hydrogen-fluorine reactive flows. The number densities of the A doublet pi and x doublet sigma states of CN in hydrogen-fluorine cyanogen compound flames were measured. It was concluded that a population inversion between these two states was not achieved even though extremely high densities of the A doublet pi state of CN were formed. The pure chemical production of the b singlet sigma plus and a singlet delta states of NF was also demonstrated. For these studies, fluorine atoms formed in the precombustor of the laser were mixed with hydrogen to produce hydrogen atoms. These hydrogen atoms then reacted with NF^2 radicals produced by the heating of N^2F^4 to produce the NF excited states. The densities measured were too low for laser production. However, the system may be scalable to laser proportions.

39286 (CONF-771035—P2, pp 871-878) **Proton beam excited lasers.** Ali, A.W. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The concept of proton beam pumped high pressure (> atmosphere) gas lasers will be discussed. Several new high pressure gas lasers produced by the application of relativistic electron beams can be excited by high energy proton beams as well. These lasers, excimer, charge exchange and energy exchange types, have a unique common denominator. They all depend on the number of atomic ions produced at the outset by the electron beam. Therefore, in prinicple, the more ionization produced, the higher will be the laser power density. MeV proton beams, traversing gaseous medium, have shorter mean free paths in comparison with electron beams of the same energy. The stopping powers of gases are much larger for protons compared to that of electrons. Therefore, protons deposit more energy per unit volume compared to electrons of the same energy, and hence create more ion pairs. Higher laser power densities will result from the application of MeV proton beams in contrast with MeV electron beams. The kinetics of a new high pressure charge exchange laser, in a gaseous mixture of He and O_2 will be dicussed. Its gain coefficient will be calculated under MeV proton beam pumping scheme indicating the possibility of a new high power laser.

39287 (CONF-771035—P2, pp 879-890) **Recent advances in cold cathode technology as applied to high power lasers.** Loda, G.K. (Systems, Science and Software, Hayward, CA). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Advances in cold cathode electron guns for laser application have continued over the last few years. Specific design and performance data are discussed for several recently constructed systems. These include a large area (12 m^2) grid controlled gun for CO_2 lasers, high current density guns for KrF lasers, and a 100 Hz triode gun for a CO_2 laser. Preliminary results on an extension of this technology to a new two electrode cathode geometry are also discussed. Issues addressed include the stability of electron emission and power supply drive requirements.

39288 (LA—7783-MS) **Bibliography of GRASER research. Informal report.** Baldwin, G.C. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 52p. Dep. NTIS, PC A04/MF A01.

The bibliography contains 161 references to literature on the problem of developing gamma-ray lasers or of observing stimulated emission or coherent spontaneous emission of nuclear gamma radiation, together with a number of references that deal with phenomena that are expected to be central to their realization. The period covered is 1917 through 1979.

39289 (LA-UR—79-675) **Simulations of free electron laser.** Kwan, T.; Godfrey, B.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—23). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The generation of coherent electromagnetic radiation by the interaction of a relativistic electron beam with a static helical magnetic field is investigated using one- and two-dimensional relativistic electromagnetic plasma simulation codes. In the one-dimensional simulations, we observed the coupling between the negative energy beam mode and the positive energy electromagnetic wave. Substantial growth rate (omega$_i$ ~ 0.1 omega/sub pe/) of the unstable electromagnetic wave has been observed and efficiency of radiation production is found to be between 25 to 30% depending on various parameters. In the two-dimensional simulations, we observed a decrease in the growth rate, but increased efficiency due to the decrease in the phase velocity of the unstable electrostatic wave. In addition, we also observed waves propagating at an angle with respect to the electron beam. Consequently, the beam is bunched in the radial as well as the axial directions. These waves are believed to be generated by another instability which saturates at relatively low level.

39290 (N—78-27404) **Life test results for an ensemble of CO^2 lasers.** Peruso, C.J.; Degnan, J.J.; Hochuli, U.E. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1978. 31p. NTIS PC A03/MF A01.

The effects of cathode material, cathode operating temperature, anode configuration, window materials, and hydrogen additives on laser lifetime are determined. Internally oxidized copper and silver-copper alloy cathodes were tested. The cathode operating temperature was raised in some tubes through the use of thermal insulation. Lasers incorporating thermally insulated silver copper oxide cathodes clearly yielded the longest lifetimes-typically in excess of 22,000 hours. The use of platinum sheet versus platinum pin anodes had no observable effect on laser lifetime. Similarly, the choice of germanium, cadmium telluride, or zinc selenide as the optical window material appears to have no impact on lifetime.

39291 (N—78-28437) **Optical and infrared lasers. Final report, 1 December 1972—31 March 1978.** Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 1 Aug 1978. Contract NGL-22-009-741. 440p. NTIS PC A19/MF A01.

Quantum mechanical predictions for the gain of an optically pumped CW FIR laser are presented for cases in which one or both of the pump and FIR transitions are pressure or Doppler broadened. The results are compared to those based on the rate equation model. Some of the quantum mechanical predictions are verified in CH^3OH.

39292 (N—78-28450) **Miniature TEA laser emitting picosecond pulses laser tea miniature emettant des pulses picosecondes.** (Battelle Memorial Inst., Geneva (Switzerland)). 14 Jul 1977. 5p. NTIS PC A02/MF A01.

A new TEA laser with a volume 100 to 1,000 times smaller than that of a commercial laser with the same peak power was developed. Due to its reduced dimensions and short pulse time, a new range of applications is possible. The main characteristics of the new high pressure nitrogen UV laser are listed. Possible applications are mentioned: plasma diagnostics and analysis in thermonuclear research; space-time impulse holography; miniature Pockels cell; miniature telemeter; pumping source for a liquid laser; energy source for pulse spectral analysis; Auston switch and other optical electronic applications; and triggerable spark gaps.

39293 (UCRL—52000-79-3) **Energy and technology review.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

Separate abstracts were prepared for the individual projects reviewed.

39294 (UCRL—52000-79-3, pp 1-6) **Tunable laser system for the ultraviolet, visible, and infrared regions.** Mar 1979.

In Energy and technology review.

A laser system that produces tunable, coherent beams of radiation covering the electromagnetic spectrum from below 200 nm in the ultraviolet to above 1000 nm in the infrared has been developed. The system uses a tunable dye laser in the visible region and converts the laser light to shorter and longer wavelengths by stimulated Raman scattering in molecular hydrogen or deuterium gas. For example, in the ultraviolet region, wavelengths as short as 171.3 nm have been generated. Tunable ultraviolet beams can be applied to atomic and molecular spectroscopy as well as to isotopic and chemical analyses.

39295 **Sulfur $^1S_0$-$^1D_2$ laser by OCS photodissociation.** Powell, H.T.; Prosnitz, D.; Schleicher, B.R. (Advanced Lasers Group, Lawrence Livermore Laboratory, Livermore, California 94550). *Appl. Phys. Lett.;* **34**: No. 9, 571-573(1 May 1979).

Strong laser oscillation has been obtained on the electric-dipole-forbidden $^1S_0$-$^1D_2$ transition of atomic sulfur using 146-nm photodissociation of OCS. A photolytic mixture of OCS with N_2 and SF_6 produced optimum laser performance. Based on the laser output energy of 5 mJ at 772.5 nm, we infer that an energy density of 2.5 J/liter was stored in the laser transition immediately following photolysis. The one-half quenching time of $S(^1S)$ atoms was approximately 1 μs for these conditions.

39296 **Picosecond photodetector for 257 nm to 1 μm laser pulses.** Steinmetz, L.L. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Rev. Sci. Instrum.;* **50**: No. 5, 582-585(May 1979).

Picasecond temporal response and broad spectral response photodetectors have been fabricated using commercially available diode chips. Improved photoresponse sensitivity is achieved by removing the anode gold contact which obscures the active region. Junction geometry is such that the depletion region is approximately normal to the surface being illuminated, making the device especially useful for fast UV photodetection.

39297 **Self-absorption of molecular fluorescence, the design of equipment for measurement of fluorescence decay, and the decay times of some laser dyes).** Hammond, P.R. (Lawrence Livermore Laboratory, Livermore, California 94550). *J. Chem. Phys.;* **70**: No. 8, 3884-3894(15 Apr 1979).

At moderate concentrations (10^{-3} to 10^{-2} M), self-absorption of the fluorescence of a dye is a major obstacle to the accurate measurement of its decay time and quantum yield. Equations are derived for this self-absorption correction for the experimental condition where the correction is minimized namely for a thin sheet of dye medium betwen parallel plates. Simple equipment is described for the determination of decay times at such concentrations. An order of magnitude estimation relates the largest exciting flux density that may be employed for a laser dye so that the measured decay time is not distorted by amplified fluorescence. Tunable, short-pulse excitation has been achieved by a nitrogen laser pumped oscillator—amplifier dye-laser configuration in which a saturable absorber is used both to shorten the oscillator pulses and to prevent feedback from the amplifier. Decay times are reported for systems containing rhodamine 6G, rhodamine B, and kiton red S for a range of concentrations between 10^{-7} M to 10^{-2} M. Self-quenching of fluorescence is minor and is not evident at concentrations below 10^{-3} M.

39298 **Optical resonance pumped transfer laser with high multiline photon-to-single-line photon conversion efficiency.** Mastrup, F.N.; Wang, J.H.S. (to Hughes Aircraft Co.). US Patent 4,145,668. 20 Mar 1979. Filed date 31 Mar 1977. 8p.

Lasers are disclosed wherein trapped multiline laser radiation from a DF laser is employed to pump a DF-CO_2 working gas mixture within the optical resonator for the DF laser. The multiline pumping energy is resonantly absorbed by the DF component of the working gas mixture and collisionally transferred to upper energy levels of lasing transitions in CO_2. A narrow-band optical resonator disposed about the working gas interaction region with the pumping radiation and tuned to a desired CO_2 transition enables a single line laser output to be obtained on the desired transition.

39299 **Cathode electrode configuration for gas laser system.** Babcock, R.V.; Pack, J.L.; Hundstad, R.L. (to Westinghouse Electric Corp.). US Patent 4,145,669. 20 Mar 1979. Filed date 10 Feb 1977. 4p.

The complexity of the conventional X-Y array of pin type cathode electrode elements employed in high-power gas laser systems, is reduced by substituting a continuous elongated cathode electrode element for one or more rows of discrete pin type cathode elements.

39300 **Glasses suitable for laser application.** Rapp, C.F. (to Owens-Illinois, Inc.). US Patent 4,142,986. 6 Mar 1979. Filed date 20 Apr 1978. 6p.

Phosphorus glasses containing beryllium and fluorine and Nd^{3+} as the active lasing species are described.

39301 **Gas discharge laser device.** Lamboo, T.F. (to U.S. Philips Corp.). US Patent 4,142,702. 6 Mar 1979. Filed date 8 Jun 1977. 4p.

A holder supporting a gas laser holder has two pairs of leaf springs, each pair being situated in a plane at right angles to the longitudinal axis of the gas discharge laser and on either side of said laser, thereby isolating the laser device from bending moments as a result of temperature gradients in the laser or holder.

39302 **Laser plasma tube having internal gas path.** Buzzard, R.J.; Mohler, G.E. (to Lexel Corp.). US Patent 4,143,339. 6 Mar 1979. Filed date 14 Mar 1977. 8p.

Several embodiments of a gas laser plasma tube are described having one or more internal gas return paths doubled back upon themselves within the structure which defines the gaseous discharge bore, to increase their length so that electrical gaseous discharge in the same is inhibited.

39303 **Solar pulser for laser pumping.** Ramer, J.L. US Patent 4,140,979. 20 Feb 1979. Filed date 27 Jun 1977. 6p.

The invention discloses an apparatus for providing solar energy to the side of a longitudinally extending laser in pulses comprising a first cylindrical opaque body having a central cylindrical bore in which the laser is mounted, the body having longitudinal passages extending radially outwardly from the central bore. The body is mounted for rotation on its longitudinal axis within a second, non-rotating longitudinally extending opaque body, the second body also having longitudinally and radially extending passages. The outer ends of the passages in the second body are provided with focusing lenses, and mirrors are pivotally mounted on the exterior of the seconnd body to direct sun light into the passages thereof. The laser may be fixed to and rotate with the first inner body, or may be fixed relative to the outer body, and not rotate.

39304 **Utilization of excited atoms in thermally initiated chemical lasers in the visible range.** Bashkin, A.S.; Kupriyanov, N.L.; Oraevskii, A.N. (P. N. Lebedev Physics Institute, Academy of Sciences of

the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1444-1449(Dec 1978).

An analysis is made of the feasibility of cw (quasi-cw) laser action in the ultraviolet and visible ranges as a result of pumping by a chemical reaction involving excited atoms. The reaction takes place during mixing of the excited atom and reactant streams. The excited atoms (first excited state) are formed by plasma recombination during rapid cooling in a supersonic nozzle. Specific reactions are proposed and it is shown that laser action by this mechanism is possible in principle using XeF and HgCl molecules.

39305 Chain-reaction chemical lasers for the visible range. Bashkin, A.S.; Kupriyanov, N.L.; Oraevskii, A.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1468-1473(Dec 1978).

The development of a chain-reaction chemical laser for the visible range utilizing chain reactions is discussed. Radicals (active reaction centers) are proposed as the active particles and the lower laser level is depopulated as a result of a chemical reaction. An analysis of the kinetics of the H_2+NF_2 chain reaction indicates that it is possible to obtain lasing due to electronic transitions in the NF molecule.

39306 Possibility of building a gasdynamic laser utilizing transitions between levels of paired CO_2 modes. Konyukhov, V.K.; Faizulaev, V.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1473-1474(Dec 1978).

Calculations of the vibrational relaxation kinetics of carbon dioxide in a Co_2—Ar mixture expanding through a slit into a vacuum are used to evaluate the feasibility of using gasdynamic thermal pumping to obtain lasing between the levels of paired CO_2 modes. It is shown that the gain due to the $(03^1 0) - (100)$ transition in CO_2 may reach 0.1 cm^{-1} and, at the optimal heating tempertures for a CO_2:Ar=1:1 mixture (T/sub i/≅1500 °K), the thermal energy conversion efficiency in the gasdynamic laser may be 12%.

39307 Fluctuations of the energy and duration of Q-switched picosecond YAG:Nd^{3+} laser radiation. Birmontas, A.; Kupris, R.; Piskarskas, A.; Smil'gyavichyus, V.; Stabinis, A. (V. Kapsukas Lithuanian State University, Vilnius). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1475-1476(Dec 1978).

A new technique is proposed to determine the fluctuations in the energy and duration of ultrashort radiation pulses. It is established that the duration of ultrshort radiation pulses from a YAG:Nd^{3+} laser is 28 +- 5 psec.

39308 Possibility of lowering the acceleration voltage of a laser electron-beam tube. Kozlovskii, V.I.; Nasibov, A.S.; Reshetov, V.I. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1477-1479(Dec 1978).

It was found possible to reduce to 20—30 keV the energy of electrons in a longitudinal beam exciting a semiconductor laser with an active medium in the form of a CdS/sub x/Se/sub 1-x/ platelet. This reduction was achieved without a significant increase in the intensity threshold of the electron beam and without a major reduction in the efficiency of conversion of the excitation energy into light above the threshold.

39309 Optically pumped Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ heterojunction lasers with matched gratings at the interface. Gureev, D.M.; Davarashvili, O.I.; Zasavitskii, I.I.; Matsonashvili, B.N.; Shotov, A.P. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1481-1483(Dec 1978).

An investigation was made of the photoluminescence emitted from epitaxial films of Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ solid solutions ($0< or =x< or \approx 0.47$, $0< or =y< or \approx 0.65$), grown by the method of liquid epitaxy on n-type PbSe substrates. Next, n-Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y//n-PbSe heterostructures, with the Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ active layer ($0.015< or =x< or =0.092$, $0.006< or =y< or =0.026$), were matched in respect of the lattice constant to the substrate ($\Delta a/a \cong 10^{-1}$-10^{-3}%) and used as optically excited heterolasers. The spectral and threshold characteristics were determined as a function of the thickness of the active layer d, temperature, and resonator length. Variation of the composition of the active layer altered the emission wavelength within the range 8-12.5 μ at 77°K. Electron and optical confinement effects were observed when the thickness d was reduced. For the optimal thickness d/sub opt/≅/ cm^2 at 77 °K. The loss factor (5.5 cm^{-1}), gain (0.11 cm/W), and carrier density (2 x 10^{17} cm^{-3}) in the active layer were determined.

39310 Influence of the degree of polarization on the gain in stimulated Raman scattering. Grasyuk, A.Z.; Grebenyuk, V.N.; Efimkov, V.F.; Izgorodin, V.M.; Kormer, S.B.; Yushko, K.B. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1483-1484(Dec 1978).

The threshold intensities were determined in the case of longitudinal pumping of a Raman laser with linearly polarized and unpolarized radiation. In the former case the threshold was half that in the latter. The corresponding gain was in agreement with the values reported by other authors.

39311 Synchronization of electron-beam-controlled CO_2 lasers with a plasma mirror. Basov, N.G.; Boiko, V.A.; Danilychev, V.A.; Zvorykin, V.D.; Lobanov, A.N.; Kholin, I.V.; Chugunov, A.Y. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1485-1486(Dec 1978).

A description is given of the methods for synchronization of emission pulses from electron-beam-controlled CO_2 lasers with a plasma mirror. These methods are based on the introduction of an optical coupling between the resonators.

39312 Tuning of the emission frequency of a dye laser with a Bragg mirror in the form of a cholesteric liquid crystal. Il'chishin, I.P.; Tikhonov, E.A.; Tishchenko, V.G.; Shpak, M.T. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1487-1488(Dec 1978).

Tuning and narrowing of the emission spectrum of a dye laser were achieved for the first time when a cholesteric liquid crystal was used as a selective Bragg reflector. The average emission frequency of this laser was a function of the spectral position of the Bragg reflection maximum of the oriented liquid crystal layer. The position of the reflection maximum was varied by altering the temperature.

39313 Generation of high power ultrashort pulses in a low-temperature ruby laser with a small active volume. Kirkin, A.N.; Leontovich, A.M.; Mozharovskii, A.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1489-1490(Dec 1978).

A short train of up to three pulses with an energy of 1 J was obtained from a ruby laser operating at a low (100°K) temperature and consisting of a mode-locked oscillator and three amplifiers with an overall active length of 48 cm. The signal was amplified coherently, the pulse duration being shortened to 5—10 psec. The product of the spectral width and pulse duration (measured at half-height) was 0.2—0.8. The pulse duration was mesured using a large-aperture shutter with a saturable filter. An echelette was used to scatter the light so as to increase the overall transmission of the shutter.

39314 Investigation of a pulsed chemical H_2—F_2 laser at high pressures of the working mixture. Kolchin, Y.A.; Kolovskii, V.B.; Pshezhetskii, S.Y.; Chebotarev, N.F. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1491-1493(Dec 1978).

A report is given of the experimental results and qualitative analysis of the operation of a chemical H_2—F_2 laser at pressures up to 5 atm in the mixture. The mixture was initiated optically with a flux of 1.5 x 10^{23} photonsxcm^{-3}xsec^{-1} using pulses of 0.7 μsec duration. Reduction of the duration of the initiation pulses at a constant pump energy increased the energy output and shifted the optimal presure of the mixture toward higher values.

39315 Influence of photoinitiating substances on stimulated emission from a chemical HF laser. Kozlov, Y.I.; Petrov, N.K.; Pshezhetskii, S.Y.; Chebotarev, N.F. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1493-1495(Dec 1978).

An investigation was made of the influence of some photoinitiating additives on the output energy of chemical lasers utilizing F_2—H_2 and ClF—H_2 mixtures. The main dependences of the laser output parameters on the pressure in the mixture, initiation power, and amounts of the additives were determined. A close relationship was found between the initiation conditions, pressure in the mixture, and effectiveness of additives. Optimal conditions were found for the operation of photoinitiated lasers utilizing mixtures with fluorine-bearing additives.

39316 Distributed-feedback semiconductor lasers operating in higher Bragg interaction orders. Borodulin, V.I.; Bykovskii, Y.A.; Goncharov, I.G.; Grachev, A.P.; Dedushenko, K.B.; Zverkov, M.V.; Konyaev, V.P.; Pashko, S.A. (Engineering-Physics Institute, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1500-1501(Dec 1978).

An investigation was made of the threshold and spatial characteristics of the radiation emitted from distributed-feedback semiconductor lasers operating in high even orders of the interaction under optical and electron pumping conditions. Distributed-feedback lasers with low thresholds, operating in high interaction orders, were consturcted.

39317 Gain measurement in a supersonic jet utilizing a $D+O_3+CO_2$ mixture. Bashkin, A.S.; Velikanov, A.G.; Gorshunov, N.M.; Kunin, Y.A.; Neshchimenko, Y.P.; Oraevskii, A.N.; Yuryshev, N.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 12, 1501-1502(Dec 1978).

The gain at the 10.6-μ wavelength was measured in a supersonic jet in which a stream of argon and atomic deuterium was mixed with ozone and carbon dioxide. The atomic deuterium was formed by thermal dissociation behind a reflected shock wave and flowed out through a supersonic nozzle at whose edge the ozone and carbon dioxide were mixed in. A change in the ejector design, from that used previously, resulted in a considerable increase in the measured gain. The achievement of a gain of 2.1 m^{-1} is reported.

39318 Investigation of the energy parameters of a chemical ClF—H_2 laser with electron-beam initiation. Bashkin, A.S.; Konoshenko, A.F.; Oraevskii, A.N.; Pshezhetskii, S.Y.; Tomashov, V.N.; Chebotarev, N.F.; Yuryshev, N.N. *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 12, 1503-1504(Dec 1978).

A study was made of the characteristics of a chemical laser utilizing a ClF—H_2 mixture and initiated by an electron beam. Stimulated emission was observed from vibrationally excited HF and HCl molecules. Since the reaction was of the chain type, relatively high stimulated emission parameters were obtained: the specific output energy was 22 J/liter; efficiency of 100% relative to the pump energy supplied to the active medium; 24% stimulated emission energy due to the HCl molecules. The higher stability of the ClF—H_2 mixture, compared with F_2—H_2, and the more efficient stimulated emission from the vibrationally excited HCl molecule (λ/ sub st/=3.6-4 μ) should make the ClF—H_2 laser more suitable for many applications.

39319 Features of high-frequency pulsation generation in a ring laser with detuning. Samson, A.M.; Loiko, N.A.; Kotomseva, K.A. *Zh. Prikl. Spektrosk.;* **29**: No. 6, 1099-1108(Dec 1978). (In Russian).

The effect of detuning of the frequency of radiation ω from the center of the line of gain of an active medium ω_0 on the regime of high frequency pulsation generation in a ring laser was examined on the basis of semiclassical equations. It is shown that the shift of ω from ω_0 leads to essential changes in the time pattern of radiation. Development conditions for pulsations with a frequency equal to or greater than the intermode beat frequency were found. The process of their formation was studied numerically.

39320 Relation of the average energy of complex molecules combining by absorption and emission. Tolkachev, V.A. *Zh. Prikl. Spektrosk.;* **29**: No. 6, 1133-1140(Dec 1978). (In Russian).

A system of equations was set up describing kinetics of generation taking into account intermolecular relaxations. The change in time of basic laser characteristics was calulated. A considerable difference was observed in rates of shift in the maximum wavelengths of gain and laser spectra. Laser conditions at the two bands were considered, pulsation of energy level populations, intensity and width of the band resulting from their competition were detected.

39321 Theoretical modelling of charge transfer lasers. Petersen, J.V. Dallas, TX; Univ. of Texas (1978). 120p. University Microfilms Order No. 78-24,323.

Thesis (Ph. D.).

A rate equation model was developed for the helium pumped nitrogen ion charge transfer laser. This model was able to quantitatively simulate many of the features of the laser that have been observed experimentally: the temporal structure of the growth of the laser pulse; the steady-state appearance of the 427.8 nm pulses; the self-termination of the 391.4 nm pulses; the relative strengths of the 391.4 nm, 427.8 nm, and 470.9 nm pulses; and the narrowing of the spectral lineshape as the laser pulse develops. The simple model that was developed is applicable to a large class of lasers in which the spatial variation of the particle and radiation densities are relatively small and can be neglected. A quantitative model for pressure broadening of emissions in molecular ions was developed to describe the effect of very high pressures on the nitrogen ion laser spectrum. A cross section for pressure broadening was calculated to be 0.27 nm^2. This broadening model indicated that the rotational structure of a bandhead can be completely obscured for pressures of only a few atmospheres. It also provided the first theoretical explanation for a shift in laser frequency of the N_2^+ laser as a function of total pressure.

39322 Characteristics of amplified spontaneous emissions in high-gain gas-laser amplifiers. Osada, H. Irvine, CA; Univ. of California (1978). 161p. University Microfilms Order No. 78-11,861.

Thesis (Ph. D.).

The propagation of broadband amplified spontaneous emission through a laser amplifier can be characterized by using two important quantities in practical laser technology, amplification and spectral change. Most practical laser amplifiers must be treated as non-linear devices, because the dynamic range of amplification is limited due to the available inverted population density and the spectral linewidth of the broadband radiation being dependent upon the intensity levels of incident radiation. Therefore, it is essential to determine these characteristic quantities for optimum design of laser amplifiers and oscillators in practical applications. The gain and spectral change under saturation effect were investigated.

39323 Blackbody optical pumping of carbon dioxide laser mixtures. Yesil, O. Seattle, WA; Univ. of Washington (1978). 180p. University Microfilms Order No. 78-20,789.

Thesis (Ph. D.).

The work illustrates the concept of blackbody radiation pumping of CO_2 laser mixtures as a step toward utilization of solar radiation as a pumping source. An attractive method whereby solar energy can be converted to laser energy very efficiently is to use an intermediate blackbody cavity. Solar light is focused into a small entrance hole to heat this cavity; because the cavity encloses the laser medium; all of the solar energy except for losses may be used to pump the laser medium. In order to demonstrate this concept, an experiment was performed in which laser gas mixtures were exposed to intense thermal radiation for brief periods of time. Gain has been measured at 10.6 μm in a CO_2—He gas mixture. The gas mixture at a temperature of 400°K with pressures on the order of 1 torr is enclosed in a sapphire tube and pumped by blackbody radiation. An electrically heated oven in the temperature range of 1500°K supplies the radiation. A CW CO_2 probe laser is used to detect the optical gain. A simplified analytical model is used to describe the rate of change of energy of the vibrational modes of CO_2. This model takes into account the presence of the blackbody radiation field but assumes that lasing does not occur.

39324 Characteristics of a distributed feedback carbon dioxide laser. Miles, R.O. Salt Lake City, UT; Univ. of Utah (1978). 160p. University Microfilms Order No. 78-22,819.

Thesis (Ph. D.).

The characteristics of a hollow-core distributed feedback CO_2 laser are derived by a plane wave analysis and perturbation theory.

39325 Transverse electrically excited iodine laser. Wong, M.C. Cincinnati, OH; Univ. of Cincinnati (1977). 79p. University Microfilms Order No. 78-21,601.

Thesis (Ph. D.).

Prompt laser emission of 100 ns FWHM on the $I(^2P\ 1/2) \rightarrow I(^2P\ 3/2)$ transition at 1.315 μm has been excited in a transverse electrical discharge. Iodine atoms in the upper and lower laser levels are generated by electron impact dissociation of i-C_3F_7I in He and uv photodissociation and/or anomalous diffusion mechanisms are shown not to be responsible for the observed emission. A kinetic model is presented which includes electron impact dissociation, attachment, collisional deactivation, ion—ion recombination, three-body iodine dimerization, and radical-atom recombination. Numerical results compare favorably with experimental data obtained in this work and published results using CF_3I in nitrogen.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 38662, 39808

39326 (SAND—78-8047) Comparison of some characteristics of finite element and finite difference calculations of transient thermal problems. Emery, A.F.; Sugihara, K.; Jones, A.T. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

The use of finite elements for short-time transient thermal problems can lead to anomalous temperature overshoot for certain boundary conditions. A typical example of this behavior was studied by using the finite element and finite difference methods. It is shown that the overshoot arises because the element method yields an upper bound to the eigenvalues. Under some conditions, the finite element method can be improved, but in general the overshoot cannot be eliminated. Because the finite difference method yields a lower bound to the eigenvalues, no such overshoot exists, and this method is to be preferred if very short time responses are desired near boundaries which undergo abrupt changes in temperature.

39327 (UCRL—82436) Wave resistance in a rotating liquid layer. Viecelli, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 12p. (CONF-790329—1). Dep. NTIS, PC A02/MF A01.

From 3. workshop on rotating gases; Rome, Italy (27 Mar 1979).

The unstable motion of a rotor containing a thin liquid layer results from the reaction forces exerted by the liquid in response to motion of the rotor. A numerical solution for the liquid displacement and pressure resulting from a traveling wave motion of the container walls is presented. The solution gives the azimuthal component of the liquid pressure force on the rotor wall as a function of Reynolds number, number of wave nodes, and the ratio of the wall displacement amplitude to liquid depth. The behavior in the limit of vanishing wave speed is derived.

39328 Analytic derivation of static pressure distribution in fully developed helical flows. Kuzay, T.M. (Argonne National Lab., IL). *J. Fluids Eng.;* **100**: No. 2, 201-203(Jun 1978).

Nondecaying helical flows are generated in turbomachinery, air pollution devices, chemical engineering processes, and along the hub of the jet engines and therefore, have wide engineering applications. In such flow systems, the static pressure is an unknown quantity analytically and very difficult to measure experimentally. This difficulty is usually due to the physical presence of the probe which tends to destroy the true pressure field when placed in the flow field. Therefore, it is very desirable to have an analytic expression to assess the static pressure in such complex flows, when the velocity field is to be explored and determined. An analytical solution to the problem is derived.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 38686, 39128, 39167, 39177

39329 Method of recording radiographic images. Matsumoto, S.; Takahashi, I.; Komaki, T.; Ishida, M.; Kozeki, T.; Horikawa, K.; Shimanuki, K. (to Fuji Photo Film Co., Ltd.). US Patent 4,121,101. 17 Oct 1978. Priority date 21 Nov 1975, Japan, 16p.

The invention relates to a method of recording radiographic images on a recording material by use of radiations such as X-rays, and more particularly to improvements in the method of recording radiographic images on a recording material by use of electrostatic latent images formed with charged particles emitted by a material which is irradiated with radiations having high energy such as X-rays or gamma rays.

VACUUM ENGINEERING

39330 Vacuum system for National Synchrotron Light Source. Schuchman, J.C.; Godel, J.B.; Jordan, W.; Oversluizen, T. (Brookhaven National Laboratory, Upton, New York 11973). *J. Vac. Sci. Technol.;* **16**: No. 2, 720-723(Mar 1979).

This paper describes the vacuum system for the National Synchrotron Light Source (NSLS) which is now under construction at Brookhaven National Laboratory (BNL). The system will consist of an electron linac, booster, vuv and x-ray storage rings, and up to 44 experimental beam lines. The pressures will range from 10^{-7} Torr in the linac and booster, to 10^{-10} Torr (without beam) in the storage rings. Stringent quality control and cleaning procedures are necessary to reduce the adverse effects of hydrocarbon contamination on optical elements which are used for beam handling. This thought is also reflected in the selection of materials, pumps, and other vacuum components, as well as in fabrication techniques. Sputter ion pumps are used throughout with distributed ion pumps and titanium sublimination pumps on the storage rings. Rough pumping is done with liquid-nitrogen-trapped turbomolecular pumps. In situ argon glow discharge conditioning is planned for the storage rings to reduce the desorption due to synchrotron radiation.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 38404, 39424

39331 (BDX—613-2173) **Deposition of aluminum—copper alloy on laminated polyimide substrates from a RF induction source.** Hale, G.J. (Bendix Corp., Kansas City, MO (USA)). Apr 1979. Contract EY-76-C-04-0613. 31p. (CONF-790442—6). Dep. NTIS, PC A03/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979)

A physical vapor deposition process with a rf induction vapor source has been developed to deposit 11.2-μm Al—Cu alloy on polyimide laminate substrates. The average thickness uniformity (standard deviation/average thickness) of the deposit acquired by a beta backscatter technique was approximately 1% for these deposits. The Al-0.3 wt % Cu vapor charge results in a Cu content in the deposit of 0.12 wt %. The Cu shows no preferential deposition pattern, as related to the surface of the laminate and its dispersion throughout the deposit. The resistivity of the Al—Cu deposits is 3.0 μΩ-cm and is stable from one deposition run to another. Also, the resistivity was not related to the geometry of the domed substrate. The density of the 11.2-μm-thick Al—Cu film was within 1% of theoretical, and its adhesion to the polyimide exceeds that required for post-deposition operations and handling. The deposited films exhibited a specular reflectance above 90% with a 632.8 nm wave length source and a grain size of 0.6 μm throughout the deposit.

39332 (CONF-771035—P2, pp 663-673) **Microwave generation and frequency conversion using intense relativistic electron beams.** Buzzi, J.M. (Ecole Polytechnique, Palaiseau, France); Doucet, H.J.; Etlicher, B. 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Some aspects of the microwave generation and frequency conversion by relativistic electron beams are studied. Using an electron synchrotron maser, the excitation of microwaves by an annular relativistic electron beam propagating through a circular wave guide immersed in a longitudinal magnetic field is analyzed. This theoretical model is somewhat more realistic than the previous one because the guiding centers are not on the wave guide axis. Microwave reflection is observed on a R.E.B. front propagating into a gas filled waveguide. The frequency conversion from the incident X-band e.m. waves and the reflected Ka band observed signal is consistent with the Doppler model for $\beta = 0.7$. This value agrees with the average beam front velocity as measured from time-of-flight using two B/sub θ/ probes. The reflection is found to occur during the current rise time. With a low impedance device (2 Ω, 400 keV) a GW X-band emission has been observed using thin anodes and a gas filled waveguide. This emission is probably due to the self-fields of the beam and could be used as a diagnostic.

39333 (CONF-771035—P2, pp 675-689) **Coherent microwave scattering from intense relativistic electron beams: a powerful, tunable source of millimeter and submillimeter radiation.** Granatstein, V.L.; Parker, R.K.; Pasour, J.A.; Sprangle, P.; Drobot, A.T. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Microwaves have been backscattered from magnetized, intense, relativistic electron beams to produce high-power outputs at a frequency far above that of the incident radiation. Two phenomena have been studied: (1) reflection from a refractive-index discontinuity near the beam front, and (2) stimulated magneto-Raman scattering from plasmons in the body of the beam. With the beam-front technique, a 250 kW incident wave at 9.3 GHz was reflected to yield a 5 MW output at 50 GHz. The center frequency of the output radiation could be tuned over an octave by changing the beam-front velocity. Stimulated scattering offers the advantage of still larger frequency shifts but requires a very high-power, incident, pump wave. A 2 cm pump wave with power $\sim$ 100 MW has been scattered to produce an output of 1 MW at 400 μm. Experiments are in progress in which the multigigawatt output from an S-band magnetron of unique design will be scattered from a 2 MeV, 0.2 TW, electron beam. Analysis of the saturation processes in stimulated Raman scattering indicates that several percent of the beam power may be converted to scattered radiation ($\lambda \sim 1$ mm) in this experiment.

39334 (CONF-771035—P2, pp 691-696) **Zero frequency pumped stimulated Raman scattering by an intense relativistic electron beam.** Schlesinger, S.P.; Efthimion, P.C. (Columbia Univ., New York, NY). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Further investigations into the physical processes involved in the generation of high powered mm and cm radiation resulting from stimulated Raman scattering by an intense relativistic electron beam in a rippled magnetic field are presented and compared for two different configurations. An estimate of growth rate magnitude and the dependence on pumping power both seem consistent with a theory.

39335 (CONF-771035—P2, pp 697-702) **Millimeter wave generation through stimulated scattering with an intense relativistic electron beam and a controlled zero-frequency pump.** Marshall, T.C.; Sandel, F.L.; Gilgenbach, R.M. (Columbia Univ., New York, NY). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Several megawatts of radiation, at $1 < \lambda < 2$ mm, have been generated by the interaction of a cold beam with a rippled magnetic field, in a scaled-up version of an earlier experiment. In one mode of operation, the beam propagates in an evacuated cylindrical waveguide along a solenoidal field (B/sub O/ $\gtrsim$ 10 kG) which includes a periodic iron structure, or undulator. The short-wavelength radiation output maximizes at B/sub O/ which depends on waveguide diameter and beam γ. A new pulsed-current, nonferro-magnetic undulator with adjustable ripple period ($\lesssim$ 1 cm) gives similar performance but with a sharper magnetic resonance; the field ripple amplitude can be increased up to 6%. The output power increases exponentially with ripple amplitude.

39336 (CONF-771035—P2, pp 703-716) **Theory of the cyclotron maser instability.** Sprangle, P.; Chu, K.R.; Drobot, A.T.; Granatstein, V.L. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The cyclotron maser instability has a two-fold importance; first, there is fundamental scientific interest in the physical processes involved in this instability; second, this mechanism is the basis for a new class of powerful millimeter and submillimeter wave generators (gyrotrons) which are finding application to r.f. heating of plasmas in controlled fusion research devices. In this paper, both the scientific aspects and the design procedures for devices based on the cyclotron maser instability are reviewed.

39337 (CONF-771035—P2, pp 717-728) **Maser electron cyclotron resonance in vacuum and plasma with REB.** Strelkov, P.S. (Lebedev Inst. of Physics, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The problem of beam space charge in a microwave generator with REB is discussed. The intense REB is injected in plasma and the degree of space charge neutralization is measured. The stimulated cyclotron radiation of spiral beam in vacuum and in plasma is observed. The microwave power in plasma is more than the power in vacuum by a factor of about one hundred. This fact is explained by neutralization of beam space charge in plasma. The investigation of maser electron cyclotron resonance in vacuum is described in the last part of the report.

39338 (SAND—78-1523C) **Radiation-tolerant high-voltage CMOS/MNOS technology.** Derbenwick, G.F.; Black, W.C. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 4p. (CONF-781210—4). Dep. NTIS, PC A02/MF A01.

From IEEE electron devices meeting; Washington, DC, USA (4 Dec 1978).

A radiation-tolerant metal-gate CMOS technology has been developed for use on non-volatile MNOS integrated circuit chips. These CMOS peripherals are capable of the high voltage operation (> 25 V) required to drive the memory array and require only the standard seven mask levels, including passivation. One additional mask is required to define the MNOS memory array. Fabrication and characterization of these circuits are described. Processing sequences compatible with known radiation-hardening procedures are defined.

39339 (SAND—78-1859C) **Controllability/observability analysis of digital circuits.** Goldstein, L.H. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 25p. (CONF-790623—1). Dep. NTIS, PC A02/MF A01.

From 1979 international symposium on fault-tolerant computing; Madison, WI, USA (20 Jun 1979).

The testability of a digital circuit is directly related to the difficulty of controlling and observing the logical values of internal nodes from circuit inputs and outputs, respectively. A method for analyzing digital circuits in terms of six functions which characterize combinational and sequential controllability and observability is presented.

39340 (SAND—79-0388C) **Extension of high temperature electronics.** Draper, B.L.; Palmer, D.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 18p. (CONF-790506—3). Dep. NTIS, PC A02/MF A01.

From 29. electronic components conference; Cherry Hill, NJ, USA (14 May 1979).

Commercial and Sandia fabricated silicon MOSFETs, thick film resistor and dielectrics, and magnetic components were investigated in an effort to increase the versatility of microelectronics used at 300°C and to form a foundation for a higher temperature technology. Commercial MOSFETs were found susceptible to parameter drifts when aged at 300°C, whereas special low alkali impurity devices were able to sustain operation at 300°C for 1000 hours without drift. Thus, although MOSFET are prone to aging, it is possible to use fabrication procedures which allow MOSFET use at high temperature.

39341 **Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron.** Orzechowski, T.J.; Bekefi, G. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Fluids;* **22**: No. 5, 978-985(May 1979).

Measurements of intense magnetron oscillations in pulsed, field-emission diodes ($\sim$350 kV, 30 nsec) subjected to crossed externally applied fields ($<$ or $\approx$16 kG) are reported. The oscillations set in as soon as the magnetic field exceeds the critical field necessary for cutting off the diode current. The oscilations are diagnosed by the microwave emission which is studied in the range from 7 to 40 GHz. The radiation is emitted in broad frequency bands, it is strongly polarized, and can be tuned by the magnetic field; the power levels are typically 1 to 5 kW. The observations are consistent with the onset of the slipping stream instability in the Brillouin space charge flow of the electron cloud.

39342 **Method for preparing a thick film conductor.** Nagesh, V.K.; Fulrath, R.M. (to Dept. of Energy). US Patent 4,130,671. 19 Dec 1978. Filed date 30 Sep 1977. 8p.

The invention discloses a method for preparing a thick film conductor which comprises providing surface active glass particles, mixing the surface active glass particles with a thermally decomposable organometallic compound, for example, a silver resinate, and then decomposing the organometallic compound by heating, thereby chemically depositing metal on the glass particles. The glass particle mixture is applied to a suitable substrate either before or after the organometallic compound is thermally decomposed. The resulting system is then fired in an oxidizing atmosphere, providing a microstructure of glass particles substantially uniformly coated with metal.

39343 **Electron and ion beam science and technology.** Bakish, R. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1978). 682p. (CONF-780571—P1).

From 153. meeting of the Electrochemical Society; Seattle, WA, USA (21 May 1978).

The seven sections of papers presented at the conference are grouped according to overriding themes. The first section deals with various components of electron lithography systems, electron optics and basic physical principles as they apply to improving system components. The second covers electron beam lithography systems. The third considers electron resists as a production rate limitation. Proximity effects are covered in section four. Section five includes the papers dealing with x-ray lithography and related topics, six covers ion implantation and ion etching, and the seventh deals with high power beams of electrons. (GHT)

39344 **Stepping motor translator.** McDowell, W.P.; Despe, O.D.; Keefe, D.J. (to Dept. of Energy). US Patent Application 853,949. 22 Nov 1977. 6p.

A stepping motor translator is provided for controlling sequential application of inputs to a stepping motor. The translator includes digital means for applying desired sequence of inputs to a stepping motor. 1 figure.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 38066, 38123, 38125, 38126, 38608, 39350

39345 **Method and apparatus for effecting uniform heat transfer in an industrial furnace.** Hemsath, K.H.; Vereecke, F.J. (to Midland—Ross Corp.). US Patent 4,142,712. 6 Mar 1979. Filed date 30 Jun 1977. 14p.

A heat treating furnace is provided with high momentum burners for uniformly heating each work item therein primarily by convective heating. A plurality of work items are spaced in a row on a furnace base and enclosed by an outer cover sealed to the base to define an enclosure therein. High momentum burners are orientated in a predetermined manner in the outer cover to fire jet streams of hot gases into the enclosure. The jet streams rapidly entrain the furnace gases to promote a gas stream of uniform temperature which swirls rapidly about each work item effecting uniform heating of each work iten primarily by convection. The furnace is further provided with an efficient internal recuperator arrangement which also functions as the flue for the furnace.

39346 **Apparatus and method to control process to replace natural gas with fuel oil in a natural gas burner.** Hoehing, W.W.; Jackson, J.M.; Johnson, E.R. (to Allied Chemical Corp.). US Patent 4,140,473. 20 Feb 1979. Filed date 13 Jan 1977. 22p.

A method whereby fuel oil is mixed with a gaseous diluent and partially vaporized, liquids separated out, superheated and burned in a natural gas burner without major modification to the burner is disclosed. The control system is: (1) a liquid level controller sensing the liquid level in the separator to automatically control the flow of the fuel oil to the vaporizer; (2) a ratio flow controller sensing the flow of the fuel oil and of the diluent to the vaporizer to automatically control the flow of the diluent to a set ratio of the flow of the fuel oil; (3) a pressure controller sensing the pressure at the vaporizer outlet and downstream overhead to automatically control the heat input to the vaporizer and optionally; (4) a flow control valve set to automatically control the flow of the separator overhead to the burner; and (5) a temperature controller sensing the temperature of the vapor effluent from the superheater to automatically control the heat input to the superheater. The vaporized fuel-diluent should be superheated to 50 to 300°F, above the dew point of mixed

vapor, preferably 100 to 275°F above. The fuel-diluent mixture should be at a steady pressure value between about 5 and 80 psig. as feed to the burner. The preferred diluent is steam.

39347 Energy-efficient oil burner. Kaplan, R.A. (to Wayne Home Equipment Co.). US Patent 4,140,476. 20 Feb 1979. Filed date 29 Jul 1977. 6p.

A gun-type burner, including a housing having side and end walls defining a plenum chamber is disclosed. A blast tube is mounted on one end wall of the housing which has an opening therein communicating between the plenum chamber and the blast tube. A fuel nozzle and ignition electrodes are positioned in the blast tube and extend into the plenum chamber. A squirrel cage blower is provided including a scroll casing with an air discharge end mounted on a side wall of the housing which has an opening therein communicating between the plenum chamber and the air discharge end of the casing. A shaded pole motor is mounted on the casing and is operatively connected to drive the blower. An electrically operated fuel pump is mounted on the housing, and an ignition transformer or solid-state ignitor is also mounted on the housing and has secondary terminals which extend into the plenum chamber and are connected to the ignition electrodes. A solenoid-actuated valve connects the fuel pump to the nozzle, and a speed-responsive switch is mounted on and operated by the motor and is coupled to energize the valve in response to motor operation. A flame detector in the plenum chamber is exposed to the blast tube, and means responsive to the flame detector is coupled to de-energize the ignition transformer in response to ignition of fuel.

39348 Method and apparatus to replace natural gas with vaporized fuel oil in a natural gas burner. Hoehing, W.W.; Johnson, E.R. (to Allied Chemical Corp.). US Patent 4,140,472. 20 Feb 1979. Filed date 13 Jan 1977. 18p.

The method, in general, includes, is mixing the fuel oil with a diluent, such as steam, vaporizing a portion of the mixed fuel oil in a vaporizer, separating the liquid from the vapor, maintaining the vapor at from about 50° to 300°F above the dew point of the mixed vapor and diluent at about 75 to 150 psig, above the pressure downstream of a valve controlling flow of the vapor mixed with diluent, and burning the vapor in a burner designed for natural gas without major modifications to the burner. The temperature and pressure can be maintained by heat from the vaporizer or by adding heat from a superheater.

39349 Process and apparatus for controlled recycling of combustion gases. Baumgartner, H.; Jacquemet, A.; Meier, J.G.; Vollerin, B. (to Pietro Fascione). US Patent 4,089,629. 16 May 1978. Priority date 12 Feb 1975, Switzerland, 10p.

Formation of nitrogen oxides and/or soot is obviated by mixing recycled combustion gas with incoming comburant supplied to a burner via a distribution opening and controlling the mass flow rate of combustion gas being recycled with respect to the mass flow rate necessary for the gaseous comburant. The mixture is passed to the burner as a turbulent flow in which the ratio between the kinetic momentum flux of the mixture and the product of the radius of the said distribution opening times the axial movement quantity flux of the mixture has a value at least sufficient so that the said turbulent flow produces a recirculation of the said mixture within the combustion chamber in the form of a toroidal vortex. This is achieved by apparatus comprising a mixing enclosure having two inlets each provided with means for regulating the size of its aperture, and an outlet, inlets communicating respectively with the atmosphere and with a duct for combustion gases, the outlet being connected to the inlet of a ventilator whose outlet communicates with gas mixture supply means arranged coaxially to a fuel injection nozzle in order to impart a turbulent motion to the gas mixture emitted from the supply means.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 38100, 38104

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 39565

39350 Removal of fine particulates from gases in fluidized beds. Doganoglu, Y.; Thambimuthu, K.V.; Clift, R.; Jog, V. (McGill Univ, Montreal, Que). *Trans. Inst. Chem. Eng. (London);* **56**: No. 4, 239-248(Oct 1978).

Experiments are reported on the collection of dust and mist particles around 1 mum in size in fluidised beds of collector particles from 100 to 600 mum. To prevent re-entrainment of dust, the collector particles were lightly coated with a non-volatile liquid. Collection efficiencies above 95% could be obtained in beds a few centimetres deep, the efficiency increasing with increasing gas velocity. An analysis is presented which distinguishes between aerosol collection in the grid jets and in the bubbling bed. The effect of gas velocity is shown to result from inertial impaction in the grid jets. Collection in the bubbling bed is determined by processes in the dense phase analogous to those occurring in fixed collector beds, with transfer between bubbles and dense phase too rapid to be controlling. This interpretation also explains discrepancies between the results of other workers. Compared with other types of dust-arresting equipment of similar efficiency, the fluidised filter requires comparable pressure drop but is much more compact. For dust collection, successful application of this device will require development of techniques to ensure retention of dust in the collector.

39351 (PB—283792) Removal of heavy metals from industrial wastewaters using insoluble starch xanthate. Final report, July 1975—June 1976. Wing, R.E.; Navickis, L.L.; Jasberg, B.K.; Rayford, W.E. (Agricultural Research Service, Peoria, IL (USA). Northern Regional Research Center). May 1978. 119p. NTIS PC A06/MF A01.

The Northern Regional Research Center developed an effective process to remove heavy metals from wastewaters of two nonferrous metal industries and insoluble starch xanthate (ISX). The study included bench-scale evaluation of wastewaters from two lead battery and one brass mill waste. The evaluation included: (1) Determination of the metals and concentrations in the raw and treated wastewaters; (2) treatment with ISX alone and in combination with selected coagulant aids; (3) recovery of heavy metals from ISX sludge; and (4) determination of the potential reuse of the treated effluent. Several other effective and economical treatment processes were also developed for specific waste streams from printed circuit manufacturers. Based on the evaluation of results in this study, recommendations were made as to the desirability of constructing a prototype plant for actual on-site testing in selected industries. This report contains an extensive bibliography of references dealing with these industries.

39352 (PB—284111) Lime/limestone scrubbing sludge characterization - Shawnee Test Facility. Final report March 1975—June 1976. Crowe, J.L.; Seale, S.K. (Tennessee Valley Authority, Chattanooga (USA)). Oct 1977. 51p. NTIS PC A04/MF A01.

The report summarizes progress on a project to determine the range of variability of the solids from scrubbers at the Shawnee Test Facility, and to attempt to correlate this variability with plant operating conditions. Slurry and solids characterization studies were conducted on 84 samples from the TCA and venturi-spray tower. The solids samples generally consisted of calcium sulfite hemihydrate (50 to 70%) and fly ash (20 to 40%) with trace quantities of gypsum, unreacted absorbent, and quartz. The form of the sulfite crystals was directly related to the absorbent used (lime or limestone), but independent of the scrubber type (TCA or venturi-spray tower). With limestone, the sulfite crystallized as well-formed single plates; with lime, it appeared as spherical, closely interpenetrating aggregates. The average size of the sulfite plates from the limestone system was inversely related to system stoichiometry; the lime system had no such relationship. The fly ash in the samples consisted of solid or hollow spheres of amorphous aluminosilicate material (sometimes containing calcium and/or iron). Slurry sedimentation behaved in three basic modes: clarification, zone settling, and compression settling. Solids morphology exerted a strong influence on settling behavior. For samples with large proportions of very small plates or complex crystalline forms, settling was inhibited.

39353 Method for removing nitrogen oxides from nitrogen oxide-containing gases. Araki, T.; Saito, H.; Funabashi, M.; Saito, R.; Seguchi, K. (to Kureha Kagaku Kogyo Kabushiki Kaisha). US Patent 4,146,450. 27 Mar 1979. Priority date 21 Jan 1977, Japan, 4p.

A method is disclosed for removing nitrogen oxides from a nitrogen oxide-containing gas by contacting the gas with ammonia excited by ultraviolet irradiation in the presence of a catalyst to react the nitrogen oxides with the ammonia. According to the method, the reaction of nitrogen oxides with ammonia proceeds more rapidly than in the case of prior art methods.

39354 Separating gaseous nitrogen oxides from other gases by paramagnetic separation in a liquid media. Vaseen, V.A. US Patent 4,142,874. 6 Mar 1979. Filed date 27 Mar 1978. 6p.

Waste gases streams, particularly products of combustion contain quantities of nitrogen oxides which are damaging to the environment. Dissolving or absorbing these gases in an inert, non-magnetic, absorber liquid provides a media which can then be passed through a high intensity magnetic field. The nitrogen oxides are subject to paramagnetic forces and thus migrate in the liquid to the poles of the magnet. Supersaturation of the nitrogen oxides near the vicinity of the poles causes the absorptive capacity of the liquid to be exceeded and the nitrogen oxides are thus stripped from the liquid. Gases such as carbon dioxide, carbon monoxide, sulphur oxides, hydrogen sulphide, hydrogen chlorine, among many, are not para-

magnetic and thus remain in the liquid, to be stripped by other means and the liquid reused.

39355 Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas. Kohama, H.; Mizukami, S. (to Kobe Steel Ltd.). US Patent 4,142,989. 6 Mar 1979. Priority date 17 Aug 1976, Japan, 8p.

The invention relates to a continuous type catalyst regeneration process for continuously heating and regenerating a degraded catalyst from a denitration apparatus and recycling the regenerated catalyst to the denitration apparatus for repeated use thereof. In accordance with the present invention, a degraded catalyst is intermittently and by predetermined amounts charged into a heating furnace through a first damper mechanism in a gas-sealed state while the surface level of a catalyst held in the heating furnace is maintained lower than the outlet of catalyst regenerating gas and is therein subjected to heat-treatment at a temperature of 400°-650°C, with catalyst-regenerating gas introduced into the heating furnace. Thus regenerated catalyst is intermittently and by predetermined amounts discharged from the heating furnace toward a second damper mechanisms through a catalyst delivery mechanism and recycled to the denitration apparatus.

39356 Control of nitrogen oxides from stationary source effluents. Burnell, L.K.; Hyde, J.D.; Kolak, N.P.; Gibbs, R.E. (to Nox Research Corp.). US Patent 4,140,651. 20 Feb 1979. Filed date 29 Apr 1977. 8p.

The invention discloses a scrubbing solution and process of use thereof, for removing nitrogen oxides from gaseous effluents from stationary sources comprising a source of sulfite anion, a basic compound, an organic surface-active agent, and water.

39357 Process for pressure stripping of sulfur dioxide from buffered solutions. Vasan, S. (to Peabody Process Systems, Inc.). US Patent 4,140,751. 20 Feb 1979. Filed date 4 Mar 1977. 8p.

A process for steam stripping sulfur dioxide from a buffered aqueous solution in which it is abosrbed in a flue gas desulfurization process is carried out at pressure greater than atmospheric. The process of pressure stripping of sulfur dioxide surprisingly results in increased steam economy as compared to stripping at atmospheric pressure and yields sulfur dioxide vapor which can be directly condensed to a liquid product with ordinary cooling water, eliminating the need for drying, refrigeration or compression operations. The high temperatures corresponding to high steam pressures enable economical use of stripping vessel overheads for preheating operations also. Stripping at pressures of 50 to 65 psig results in steam requirements which are only one-third to one-half of that at atmospheric pressure stripping. At the high pressures lower gas flow rates permit the use of more compact stripping equipment.

POWER CYCLES

BRAYTON

REFER ALSO TO CITATION(S) 39267

OTHER

39358 Energy generating device. Cruz, L.R. US Patent 4,145,890. 27 Mar 1979. Filed date 25 Mar 1977. 4p.

An elongated arm, pivotally mounted at the center to a support structure, includes a large, bolbous reservoir attached at either end thereof. The arm is hollow and a passageway therethrough joins the two reservoirs. A volatile fluid which vaporizes at a relatively low temperature (125°F, or less) is placed within the reservoir/passageway to provide the activating fluid for the device. A source of heat input is provided in heat exchange relationship with each reservoir when pivoted to its lowermost point, causing the volatile liquid to vaporize and flow to the other end where it condenses, causing the other end to lower. An electrical generator or other eergy converter is operatively associated with an operated responsively to the movement of the arm.

PARTICLE ACCELERATORS

39359 (LA—7445-C) **SNEAP: Symposium of North-Eastern Accelerator Personnel.** Woods, R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 285p. (CONF-770948—). Dep. NTIS, PC A13/MF A01.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Membership in the Symposium of North-Eastern Accelerator Personnel (SNEAP) is made up of institutions with electrostatic (Van de Graaff) accelerators. The annual symposium is attended by individuals who have the responsibility for operation, maintenance, and development of these accelerators. One or two invited or contributed talks open each session, and then general discussion of the talks and related topics is solicited by the session chairman from the attendees. These discussions are usually very productive and contain the major volume of information in these proceedings.

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 38225, 39877

39360 (CONF-780622—30) **Nuclear performance of target-blanket assemblies for electronuclear fuel production.** Alsmiller, R.G. Jr.; Gabriel, T.A.; Barish, J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 49p. Dep. NTIS, MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Portions of document are illegible.

The results of calculations of high energy transport carried out to evaluate the nuclear performance of several of the designs that have been proposed for electronuclear fuel production are presented. Topics covered include: results for 1-GeV protons and 1-GeV deuterons incident on a lithium target surrounded by a ^{238}U blanket; results for 1 GeV protons and 1-GeV deuterons incident on a thorium salt; results for 1-GeV protons, incident on a gas-cooled system fueled by either $^{238}UO_2$ or $^{232}ThO_2$; and results for protons in the energy range 0.5 to 10 GeV incident on a very large natural uranium target. (GHT)

39361 (LA—7445-C, pp 31-40) **Staffing for operational safety and efficiency.** Woods, R. (Los Alamos Scientific Lab., NM). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Accelerator safety, other than radiation safety, is discussed from a staffing standpoint. Problems in providing qualified operators are covered, and maintenance schedules are considered. (GHT)

39362 (LA—7445-C, pp 41-59) **Telemetry systems: a review and a forecast.** McNaught, R. (McMaster Univ., Hamilton, Ontario). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Methods of telemetry in Van de Graaff accelerators are reviewed. (GHT)

39363 (LA—7445-C, pp 61-83) **Installation of NEC tubes in the Argonne National Laboratory FN.** Billquist, P. (Argonne National Lab., IL). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

A description is given, with illustrating photographs, of the conversion to NEC beam tubes in the Van de Graaff FN model tandem at Argonne National Laboratory. 20 figures. (GHT)

39364 (LA—7445-C, pp 89-103) **Belt charging system, characteristics, problems, structures.** Letournel, M. (Univ., Strasbourg, France). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Electric fields on the charging belt of the MP model tandem Van de Graaff during operation are discussed. Ways of avoiding electrical damage to the belt are proposed. (GHT)

39365 (LA—7445-C, pp 104-112) **Problems with our upgraded 3-MV machine.** Janzen, H. (Queens Univ., Kingston, Ontario). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Operational difficulties involving electrical breakdown in the 3MV Van de Graaff are described. Changes in insulating gas and beam tube are discussed. (GHT)

39366 (LA—7445-C, pp 139-173) **Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture.** Sato, K. (Yale Univ., New Haven, CT). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Investigations into the behavior of insulating gas mixtures in the MP tandem Van de Graaff accelerator are reported. Data are presented which led to the selection of an optimum gas mixture of $SF_6/N_2/CO_2/H_2O$ at 210 psia permitting operation at a terminal voltage of 16 MV (with 18 foot tank diameter). 31 references, 3 figures, 10 tables. (GHT)

39367 (LA—7445-C, pp 199-201) **Synopsis of tritium running at Penn.** Middleton, R. (Univ. of Pennsylvania, Philadelphia). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Acceleration of beams of tritium ions in the Van de Graaff accelerator at the University of Pennsylvania is described. Methods for loading titanium cones containing tritium into the cesium sputter ion source, and system performance are discussed. (GHT)

39368 (LA—7445-C, pp 203-211) **Carbon-14 dating using a tandem.** McKay, J. (McMaster Univ., Hamilton, Ontario). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Use of the tandem Van de Graaff accelerator as a mass spectrometer to determine carbon 12 to carbon 14 ratios for archeological dating is discussed. Preliminary details on performance are given. (GHT)

39369 (LA—7445-C, pp 213-222) **Proposed upgrading of an EN tandem for heavy ions.** Laughlin, W. (Univ. of Pittsburgh, PA). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Upgrade conversion of the EN tandem includes: provide power in the terminal with a 3 KVA alternator; rebuild the terminal canal to accommodate the foil changers and local pumps; design the titanium sublimation pumps; provide necessary control for the pumps and foil changers. These proposed changes are disscussed. (GHT)

39370 (LA—7445-C, pp 223-229) **Progress on the Oak Ridge tandem.** Bair, J. (Oak Ridge National Lab., TN). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Photographs of construction taking place on the Holifield Heavy Ion Research Facility are shown. (GHT)

39371 (LA—7445-C, pp 231-234) **Major improvements at Brookhaven since the beginning.** Thieberger, P. (Brookhaven National Lab., Upton, NY). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Upgrade modifications made on the MP tandem Van de Graaff facility at Brookhaven National Laboratory since 1973 are listed. Performance of the accelerator is discussed. (GHT)

39372 (LA—7445-C, pp 235-236) **Stony Brook booster project update.** Schultz, E. (State Univ. of New York, Stony Brook). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

The proposed addition of Pelletron chain charging to the Stony Brook tandem Van de Graaff, along with new accelerator tubes and vacuum pumps, is discussed. (GHT)

39373 (LA—7445-C, pp 237-240) **Status of Laddertron development at HVE.** Shaw, J. (High Voltage Eng. Corp., Burlington, MA). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Performance of the Laddertron inductive charging system for the MP tandem Van de Graaff is described. Charging characteristics are discussed. (GHT)

39374 (LA—7445-C, pp 241-248) **Improved MP acceleration tube performance.** Thieberger, P. (Brookhaven National Lab., Upton, NY). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Improvements in the optical, voltage holding, and vacuum qualities of acceleration tubes of MP tandem Van de Graaff accelerators are discussed. Inclined fields and magnetic suppression are covered. (GHT)

39375 (LA—7445-C, pp 249-265) **Thoughts on accelerator tubes.** Larson, J.D. (Oak Ridge National Lab., TN). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

A brief, subjective review is given of mechanisms that may be limiting electrostatic accelerator tubes to present levels of performance. Suggestions are made for attacking these limitations with the purpose of stimulating the thinking of designers and users of electrostatic accelerators.

39376 (LA—7445-C, pp 266-276) **Experience with accelerating tubes.** McKibben, J.L. (Los Alamos Scientific Lab., NM). Sep 1978.
From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Development of accelerator tubes is reported, from early versions assembled with sealing wax to recent inclined field tubes. Insulator performance is discussed, and possible solutions to electrostatic charging of insulator surfaces are proposed. (GHT)

39377 (LA—7650-PR) **Medium-energy physics program. Quarterly report, May 1—July 31, 1978.** van Dyck, O.B.; Dunn, E.D. (comps.). (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 68p. Dep. NTIS, PC A04/MF A01.

LAMPF operating Cycle 20, with 43 days of accelerator operation at 330- to 360-$\mu A H^+$ beam current is reviewed. Polarized beam was also used about half the time. New operating modes were implemented to supply special tailoring of the beam time structure for several users. Development work concentrated on linac emittance measurement techniques and on low-momentum muon beam characteristics. The large spectrometer systems were in full use. First results from the neutrino program were obtained.

39378 **Neutron physics at LASL.** Keyworth, G.A. (Los Alamos Scientific Lab., NM). pp 247-279 of Third international school on neutron physics. Dubna, USSR; Joint Inst. for Nuclear Research (1978).

From 3. international school on neutron physics; Alushta, USSR (19 Apr 1978).

The Los Alamos Scientific Laboratoy has maintained an active program in the general area of neutron physics since the Laboratory's inception during the second World War. Intial efforts were devoted primarily to the study of neutron-induced fission of the heavy elements. Current areas of research use neutrons whose energies range nearly continuously from thermal to 800 MeV. A new pulsed neutron time-of-flight facility using the 800-MeV proton linac of the Los Alamos Meson Physics Facility (LAMPF) is being placed in operation. With the inclusion of the Proton Storage Ring, scheduled for completion in 1982, this facility will offer a new dimension in pulsed neutron sources. An overview of the total program as LASL is given; the scope of experimental capabilities and major research interests are described with particular emphasis on the emerging research program at the new LAMPF time-of-flight facility. 16 figures, 1 table. (RWR)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 39429, 39430, 39436, 39439, 39456, 39459, 39467, 39469, 39470, 39478, 39479, 39483, 39485, 39771

39379 (AD-A—059337) **High intensity electron beam propagation between two plane conductors and its implications for collective ion acceleration.** Uhm, H.S.; Kim, H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1978. 28p. NTIS PC A03/MF A01.

This paper examines the properties of a high-intensity relativistic electron beam propagating between two grounded plane conductors, with particular emphasis on the implications for collective ion acceleration. The steady-state and time-aeraged equilibrium properties are obtained analytically, by employing a one-dimensional model. Numerical integration of pulsed-beam propagation is shown to result in an oscillatory state around the time-averaged equilibrium solution. Based on this investigation, a model of linear beam collective ion acceleration is presented. It is shown that, within a few nanoseconds of acceleration time, the ion kinetic energy can be increased to more than ten times electron energy.

39380 (BNL—25788) **Bunched beam neutralization.** Gammel, G.M.; Maschke, A.W.; Mobley, R.M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 2p. (CONF-790327—65). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

One of the steps involved in producing an intense ion beam from conventional accelerators for Heavy Ion Fusion (HIF) is beam bunching. To maintain space charge neutralized transport, neutralization must occur more quickly as the beam bunches. It has been demonstrated at BNL that a 60 mA proton beam from a 750 kV Cockcroft—Walton can be neutralized within a microsecond. The special problem in HIF is that the neutralization must occur in a time scale of nanoseconds. To study neutralization on a faster time scale, a 40 mA, 450 kV proton beam was bunched at 16 MHz. A biased Faraday cup sampled the bunched beam at the position where maximum bunching was nominally expected, about 2.5 meters from the buncher. Part of the drift region, about 1.8 meters, was occupied by a series of Gabor lenses. In addition to enhancing beam transport by transverse focussing, the background cloud of electrons in the lenses provided an extra degree of neutralization. With no lens, the best bunch factor was at least 20. Bunch factor is defined here as the ratio of the distance between bunches to the FWHM bunch length. With the lens, it was hoped that the increased plasma frequency would decrease the neutralization time and cause an increase in the bunch factor. In fact, with the lens, the instantaneous current increased about three times, but the bunch factor dropped to about 10. Even with the lens, the FWHM of the bunches at the position of maximum bunching was still comparable to or less than the oscillation period of the surrounding electron plasma. Thus, the electron density in the lens must increase before neutralization could be effective in this case, or bunching should be done at a lower frequency.

39381 (CONF-771035—P2, pp 497-507) **Collective ion acceleration in a vacuum diode.** Adamski, J.L.; Wei, P.S.P.; Beymer, J.R.; Guay, R.L.; Copeland, R.L. (Boeing Aerospace Co., Seattle WA). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Recent experiments in a Luce-Type vacuum diode have been made utilizing time-resolved spectroscopic measurements of anode plasma expansion velocity by line broadening and Doppler shift techniques, electrostatic and magnetic probe measurements of space charge potential well movement, time of flight Faraday cup measurements, and nuclear activation ion energy measurements. Preliminary results using a 3 MeV, 90 KA, 40 nsec electron beam from the FX-75 accelerator show mean proton energies between 5 to 10 MeV with an energetic tail in excess of 30 MeV with corresponding 10 to 20 KA peak ion current and 5 to 10 nsec pulse width. Ion beam current modulation has been observed as a result of the typical diode current modulation due to accelerator waveguide reflections. A brief discussion of a modified one-dimensional ion emission law is given and the results will be compared to the Olson model for gas ionization neutralization.

39382 (CONF-771035—P2, pp 509-520) **Wave accelerator for collective ion acceleration.** Adler, R. (Cornell Univ., Ithaca, NY); Gammel, G.; Nation, J.A.; Read, M.E.; Williams, R.; Spragle, P.; Drobot, A. 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Aspects of the experimental program at Cornell for the generation of a large amplitude space charge wave, suitable for the demonstration of a wave particle accelerator, are presented. An account is given of the wave growth in a slow wave structure, and of the measured values of the electric field and phase velocities of the wave, after extraction into a uniform tube. The electric field measured is in excess of 30 kV/cm and the phase velocities consistent or slightly lower than the expected values. Progress towards the development of a suitable ion source for use as an injector is also summarized and experiments designed to elucidate the collective processes involved are described.

39383 (CONF-771035—P2, pp 521-532) **Linear beam collective ion acceleration for fusion applications.** Destler, W.W.; Kim, H. (Univ. of Maryland, College Park). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

At the University of Maryland, studies of the collective acceleration of protons and heavy ions using a Luce diode configuration have been underway for several years. Systems of floating electrodes and/or slow-wave structures downstream of the diode have been investigated in an attempt to increase the accelerated ion energy. Using a 1.5 MeV, 30 kA, 30 ns electron beam pulse, proton energies in excess of 16 MeV and heavy ion (carbon, nitrogen) energies greater than 50 MeV have been achieved. Typical ion current is estimated to be 1 kA or greater, and the collective accelerating field in the post diode region has been measured to be greater than 100 MV/m. The possibility of achieving heavy ion pellet fusion by using collective ion accelerators of this type as injectors for higher energy accelerators will be discussed in the context of observed ion beam properties.

39384 (CONF-771035—P2, pp 533-540) **New collective particle accelerator.** Friedman, M. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

A simple and novel mechanism for a collective particle accelerator is proposed. It is suggested that a density modulated intense relativistic electron beam propagating in a spatially modulated magnetic field can drag particles (electrons or ions) and accelerate them to high energies. This new mechanism can generate high particle current. A strong radial electric field exists in the mechanism ensuring radial confinement of the accelerated ions.

39385 (CONF-771035—P2, pp 553-564) **Dielectric guide controlled collective ion acceleration.** Greenwald, A.; Little, R. (Spire Corp., Bedford, MA). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Relativistic electron beams with $V/\gamma \simeq 1$ have been propagated in a hard vacuum without external magnetic fields through cavities lined with dielectric materials. Charge neutralization was provided by ions removed from the surface of the dielectric liner by intense radiation bombardment. Protons were accelerated to energies 2 to 10 times the peak electron energy (70 to 100 keV). Ion energy increased with the cavity length. Ion velocity scaled directly as the injected current density. A model of the acceleration mechanism, correlating ion velocity with that of the electron beam front, will be presented. Subsequently, this work was scaled to higher energies.

39386 (CONF-771035—P2, pp 565-576) **Transverse stability in an electron ring accelerator.** Hofmann, I. (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Suppression of coherent transverse instabilities is a basic requirement for stable operation of an electron ring accelerator experiment. Landau damping of the unstable radial electron-ion modes and the resistive wall modes may be insufficient after final compression of the ring owing to the curvature and image effects. A specific choice of image focussing and ion loading is then required in order to avoid a large reduction of ring quality. The theoretical implications of this situation, which affects the stable working range of a heavy ion electron ring accelerator, are studied for parameters relevant to the Garching Pustarex experiment.

39387 (CONF-771035—P2, pp 577-583) **Autoacceleration of electron beam and microwave radiation in the diaphragmed waveguide.** Kolomensky, A.A.; Meskhy, G.O.; Yablokov, B.N. (Lebedev Inst. of Physics, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The energy of a portion of beam electrons can be increased by means of the autoacceleration mechanism. In these experiments, an electron accelerator with parameters 0.5 to 1.0 MeV, 20 to 30 kA, 40 to 50 ns was used. A hollow beam was passed through a diaphragmed waveguide. At its output, the electron spectrum and microwave spectrum were measured simultaneously. About 10% of the electrons increase their energy as compared with the maximum input energy, whereby 3% increase their energy more than by a factor of two. The energy multiplication for the tail electrons turns out to be 3 to 4 times the initial value. About 10% of the beam input power is spent on the increase of electron energy. The pulse microwave power generated is in the range 2.7 to 2.9 GHz and its total measured power was $\sim$ 0.4 GW, which corresponds to $\sim$ 20% of the input beam power. Experiments show that effects of autoacceleration and microwave generation are interdependent and should be studied together.

39388 (CONF-771035—P2, pp 585-600) **Theoretical and experimental investigations of the autoaccelerator.** Lockner, T.; Siambis, J.; Friedman, M. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Theoretical and experimental work on the coaxial autoaccelerator is presented. The theoretical investigation of instabilities in the autoaccelerator is divided into two areas: resonant and nonresonant interactions. The coaxial autoaccelerator is found to be stable against resonant instabilities such as the longitudinal bunching mode and transverse beam breakup mode because it does not behave as an efficient slow wave structure. From the large class of nonresonant

instabilities, the klystron instability has been examined in detail. A stability criterion has been obtained which indicates stability for the projected operating parameters in the experiment. A long pulse (800 ns risetime) beam generator is described capable of producing a ramp charging beam pulse of 1.5 MV peak voltage and 50 KA peak current. The beam generator is equipped with a self break oil switch capable of reducing the peak beam current by a factor of four in less than 5 ns. Experiments on the generation and propagation of beams with peak voltages and currents of 1.1 MV and 35 KA are discussed. Initial experimental results on one-cavity beam autoacceleration, in agreement with theoretical predictions, will be presented. Operation of a six cavity system is anticipated in the near future.

39389 (CONF-771035—P2, pp 601-612) **Beam trapping experiments on the University of Maryland Electron Ring Accelerator.** Meger, R.A.; Hudgings, D.W.; Rhee, M.J. (Univ. of Maryland, College Park). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The University of Maryland Electron Ring Accelerator experiment involves a collective ion acceleration scheme in which a cusp injected hollow rotating electron beam is used for the acceleration of ions. Essential to this scheme is the slowing and trapping of a nonneutral electron ring in some form of a magnetic mirror system. As a first step in this direction, preliminary experimental results on the interaction of nonneutral E-layer beams with static magnetic mirrors are reported. Also, results from initial experiments on the interaction of E-layer beams and a background neutral gas to be used in ring trapping and ion loading are presented. Detection of a small number of ions in the ERA chamber using cellulose nitrate films is also reported.

39390 (CONF-771035—P2, pp 623-634) **Collective ion acceleration and intense electron beam propagation within an evacuated dielectric guide.** Pasour, J.A. (Naval Research Lab., Washington, DC); Parker, R.K.; Doggett, W.O.; Pershing, D.; Gullickson, R.L. 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Experiments were conducted to extend a previous study of collective ion acceleration and electron beam propagation within an evacuated dielectric guide to higher beam energies. The typical electron beam injection conditions were as follows: current $\sim$ 65 kA, voltage $\sim$ 1.5 MV, $\nu/\gamma \sim 1.4$ and pulse duration $\sim$ 60 nsec. Beam propagation was found to depend upon space charge neutralization resulting from ions released from the walls of the dielectric guide. The primary energy loss mechanism was found to be erosion of the beam front. With a diode consisting of a small diameter cathode but no anode foil, protons with kinetic energies up to 14 MeV were detected on axis using nuclear activation techniques. The maximum observed yield was $\sim 10^{13}$ protons ($E > 3.8$ MeV).

39391 (CONF-771035—P2, pp 635-645) **Toroidal collective accelerator for heavy ions.** Rostoker, N. (Univ. of California, Irvine). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Electrons can be confined in a bumpy torus so that they are effectively trapped by mirror magnetic fields and do not circulate around the torus. This has been confirmed by experiments at Maxwell Laboratories. Based on this result, we propose a heavy ion accelerator in which ions are confined and focused by the net space charge of the electrons. Then an inductively applied toroidal electric field of about 10 volts/cm will accelerate ions without accelerating electrons. The reason for this is that, whereas the electron dynamics is adiabatic, the ion dynamics is not, and the magnetic fields have little effect on ions. In this paper, this conjecture is proven, self-consistent equilibria for electrons and ions are obtained and stability problems are investigated. A conceptual design is evaluated in which uranium ions are accelerated to produce 100 Terawatt pulses at 100 GeV. The major radius of the torus required is 3 to 5 meters, and the design is based on existing technology.

39392 (CONF-771035—P2, pp 743-754) **Microsecond intensive e-beams.** Abramyan, E.A.; Altercop, B.A.; Kuleshov, G.D. (Inst. of High Temperatures, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The scientific and technical problems which can be solved by use of long pulse tau $\sim 10^{-6}$ to 10^{-3} sec, high power 10^{9} to 10^{7}J electron beams and the technical possibilities of generating such beams are dicussed. Some physics and technical aspects of the forming, transport and stability of beams and different types of the pulse power sources are considered. A prospective design of a compact multichannel acceleration 1 MeV, 1 kA range tube is proposed.

39393 (CONF-771035—P2, pp 755-760) **Energy recovery and power stabilization of pulsed electron beams in Marx generator circuits.** Abramyan, E.A.; Efimov, E.N.; Kuleshov, G.D. (Inst. of High Temperatures, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

A possibility of increasing the electron beam pulse duration and current in accelerators fed from the capacitive storage systems with the electron-beam energy recovery is described. A simple scheme for correction of the pulse shape of the generator voltage allows keeping in a quasi-constant level of the voltage on the acceleration tube for the pulse time, thus stabilizing the beam parameters: energy, current, and power. The experimental results are given.

39394 (CONF-771035—P2, pp 761-770) **Properties of cathode plasma in the diode with magnetic insulation.** Baksht, R.B.; Bougaev, S.P.; Koshelev, V.I.; Mesyats, G.A. (Inst. of High-Current Electronics, Tomsk, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The results of investigations of the cathode plasma properties formed in the magnetic field in the process of the explosive emission are given. It has been shown that electron beam duration in the diode with the magnetic insulation is determined by the time of closing the gap by the plasma. The measured plasma velocity across the magnetic field with $B \geqq 10^{4}$ G is equal to 0.45 cm/μs and did not depend on the cathode material (C, Al, Cu). The cathode plasma composition is investigated. It has been shown that the cathode material and the cracking products are present in the plasma. The possible mechanism of plasma velocity decrease in the magnetic field is discussed.

39395 (CONF-771035—P2, pp 771-780) **Study of 200KA REB focussing depending on the Kalmar diode geometry.** Demidov, B.A.; Ivkin, M.V.; Petrov, V.A.; Smirnova, E.A.; Fanchenko, S.D. (Inst. of Atomic Energy, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

High-power relativistic electron beam focussing represents an important problem to be solved in order to make the controlled pulsed electron fusion feasible. As shown by L.I. Rudakov, a relativistic electron beam with a current 10^{7} A and a power density in the beam 10^{13} W/cm^{2} is required. The Kalmar-1 accelerator, producing a relativistic electron beam with a 5×10^{11} to 5×10^{12} W/cm^{2} power density, is described. The results on the relativisitic electron beam focussing as a function of electrode geometry and voltage prepulse in the high-voltage diode are presented.

39396 (CONF-771035—P2, pp 793-805) **REB focusing and transport investigations.** Kolomensky, A.A.; Krastelev, E.G.; Lebedev, A.N.; Voronin, V.S.; Yablokov, B.N. (Lebedev Inst. of Physics, Moscow, USSR). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Many important physical and technical problems are related to beam transportation in vacuum channels, energy transportation in vacuum transmission lines, and to possibilities of energy and power compression. All these problems require a common approach, e.g., control of high-current electron flows in a two-electrode geometry. Some related investigations carried out in the P.N. Lebedev Physical Institute are discussed.

39397 (CONF-771035—P2, pp 833-844) **Performance characteristics of large area electron accelerators.** Nablo, S.V.; Frutiger, W.A.; Denholm, A.S. (Energy Sciences Inc., Bedford, MA). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

The performance characteristics of planar electron accelerators using hot cathodes, and operating in the 150 to 500 kilovolt range will be reviewed. Self-shielded units utilizing barium dispenser cathodes capable of providing variable pulse width (10^{-3} to 10^{-6} secs) at variable repetition frequency, with peak window current densities to 15 mA/cm^{2} are discussed. Some of the problems peculiar to the diagnosis of these relatively low energy beams will be reviewed with attention to the limitations of available thin film dosimeters suitable for this energy regime. The use of these techniques for the determination of beam quality differences between beams generated by these systems and comparable cold-cathode units will be discussed. In addition to the plasma physics applications of these

energy sources, a number of processes of industrial interest involving cw initiation of chemical reactions have been commercialized over the past two years. The high energy efficiency offered by these all electric systems as compared with their thermal counterparts has generated increasing interest in these energy sources since the crisis of 1973. Self-shielded units up to 1.4 meters long and rated at 200 kV continuous operation at 20 kW will be described. Some of the problems peculiar to the introduction of this type of energy source into the non-laboratory environment will be treated, with discussion of federal and state regulations affecting their use.

39398 **Role of space charge in beam transport.** Osher, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 201-211 of Low energy ion beams, 1977. Stephens, K.G.; Wilson, I.H.; Moruzzi, J.L. (eds.). Bristol, England; Institute of Physics (1978).

From International conference on low energy ion beams; Salford, UK (5 Sep 1977).

This paper reviews space charge as it affects ion beam transport. The approach here will be (i) to derive beam current criteria for divergence from space charge; (ii) review recent theoretical models for fractional space-charge neutralisation; (iii) discuss space-charge-related observations on ion beam transport in a specific experimental system, and (iv) briefly note several applications using space charge. Experimental measurements of effective space charge are discussed for a DC ion source test stand using a 90° double-focusing magnet for species separation and for a solenoidal lens magnet for trim focus of the ion beam before its entrance into a 400 kV accelerator column.

39399 (LA—7445-C, pp 230) **Comments on Coulomb explosion experience at Brookhaven.** Thieberger, P. (Brookhaven National Lab., Upton, NY). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Use of a gas prestripper canal to prevent Coulomb explosion dissociation in molecular ion beams is described. [GHT]

39400 (LA-UR—79-676) **Computational study of one aspect of autoresonant accelerator.** Shanahan, W.R.; Faehl, R.J.; Godfrey, B.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (P). (CONF-790327—19). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Excitation and suppression of zero-frequency cyclotron waves on a relativistic electron beam in a parameter regime appropriate to autoresonant collective ion acceleration are examined through numerical simulation. The excitation mechanism considered is that of anode shorting, while suppression is achieved through a combination of nonadiabatic change in the guide magnetic field and the introduction of a finite radial velocity divergence in the beam. Some brief remarks are included concerning the effect of a scattered beam distribution.

39401 (LA-UR—79-695) **Radio frequency quadrupole accelerating structure research at Los Alamos.** Potter, J.M.; Williams, S.W.; Humphry, F.J.; Rodenz, G.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—13). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The results of studies of radio frequency quadrupole accelerating structures are presented. Measurements indicate that this is a promising structure for transporting and accelerating ion beams in the energy region of 50 KeV to 2 MeV.

39402 (LA-UR—79-699) **Method of transfer maps for linear and nonlinear beam elements.** Dragt, A.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—37). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Transfer matrix methods are widely used to calculate properties of particle orbits as they pass through linear beam elements such as drift spaces, bending magnets, and quadrupoles. A new method of "transfer maps" has been developed to also include nonlinear transformations that result from nonlinear beam elements such as sextupoles, octupoles, etc. The method of transfer maps therefore provides a complete theory of beam transport through both linear and nonlinear elements. In particular, it is possible to use transfer maps in the context of circular machines to study tune shifts, structure resonances, stop band widths, emittance growth rates, etc. Consequently, the method of transfer maps provides an alternative to the method of Hamiltonian perturbation theory usually employed for this purpose.

39403 (LA-UR—79-701) **Stable particle motion in a linear accelerator with solenoid focusing.** Wadlinger, E.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—41). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The equation governing stable particle motion in a linear ion accelerator containing discrete rf and either discrete or continuous solenoid focusing was derived. It was found for discrete solenoid focusing that: $\cos\mu = (1 + d\Delta)\cos\theta/2 + (l\Delta/\theta - d\theta/2l - \theta\Delta d^2/4l)\sin\theta/2$, $\Delta = 1/f$ and $l + 2d = \beta\lambda$, where μ, θ, f, l, and d are the phase advance per cell, precession angle in the solenoid, focal length of the rf lens, length of the solenoid in one cell, and the drift distance between the center of the rf gap and the effective edge of the solenoid. The relation for a continuous solenoid is found by setting d equal to zero. The boundaries of the stability region for θ vs Δ with fixed l and d are obtained when $\cos\mu = +\text{-}1$.

39404 (LA-UR—79-709) **Linac particle tracing simulations.** Lysenko, W.P. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—29). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A particle tracing code was developed to study space—charge effects in proton or heavy-ion linear accelerators. The purpose is to study space—charge phenomena as directly as possible without the complications of many accelerator details. Thus, the accelerator is represented simply by harmonic oscillator or impulse restoring forces. Variable parameters as well as mismatched phase—space distributions were studied. This study represents the initial search for those features of the accelerator or of the phase—space distribution that lead to emittance growth.

39405 (LA-UR—79-710) **Study of a 90° bending magnet for H^- beams.** Sherman, J.D.; Allison, P.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—30). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Three different magnetic pole face configurations with field indices not equal to 0 have been studied to minimize second-order magnetic focusing aberrations. One pole face with a substantial second-order magnetic field inhomogeneity reduces the measured aberration coefficient to zero. A calculation using first- and second-order ion optics provides a qualitative explanation for the aberration variations seen in these magnets. The pepper pot emittance measurement technique was used.

39406 (LA-UR—79-750) **LAMPF primary beam line protection system.** Macek, R.J.; Hoffman, E.W.; van Dyck, O.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—47). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

An effective system for the protection of LAMPF primary beam lines has been built and installed. In three years of operations, it has prevented major damage from the effects of very high intensity (up to 600 μA) errant beams. The harsh environment of the target cells poses a major technical problem requiring the design of highly radiation hardened, remotely serviceable components capable of handling high thermal loads often in vacuum. After a brief discussion of general system considerations, the five major subsystems are described including design criteria, special problems encountered in implementation, operational effectiveness and planned improvements.

39407 (LA-UR—79-751) **800-MeV spin precessor for polarized H^- beams using H^- to H^0 stripping.** van Dyck, O.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—48). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A new method is described for precessing the proton polarization axis of the incident H^- polarized beam at LAMPF. The method uses a thin stripper to convert H^- to H^0 with ~ 50% efficiency at 800 MeV, and uses relatively small magnets to precess the H^0 spin. The large magnetic moment of the H^0 relative to the charged ion (either H^+ or H^-) allows small magnets to produce any required spin orientation (with zero deflection of the neutral beam in the precession apparatus). Either H^0 or H^+ beam is delivered; for H^0, the magnitude of the proton polarization oscillates in proper time at the hyperfine frequency. The theory and test results will be summarized. Areas of possible application will be mentioned, including use for experiments and spin axis control where neutral beams can be used for injection of accelerated H^- beams into storage rings or synchrotrons.

39408 (LA-UR—657) **Rf quadrupole beam dynamics.** Stokes, R.H.; Crandall, K.R.; Stovall, J.E.; Swenson, D.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—25). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A method has been developed to analyze the beam dynamics of the radiofrequency quadrupole accelerating structure. Calculations show that this structure can accept a dc beam at low velocity, bunch it with high capture efficiency, and accelerate it to a velocity suitable for injection into a drift tube linac.

39409 (LBL—7574, pp 53-55) **Overview of beam cooling.** Sessler, A.M. (Univ. of California, Berkeley). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

History of efforts to develop beam-cooling ideas is covered, and elementary and simplified descriptions of the two successful methods of beam cooling are presented.

39410 (LBL—7574, pp 73-77) **Stochastic cooling theory and devices.** Van der Meer, S. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Stochastic cooling methods are discussed. Topics covered include mixing, momentum cooling, scaling, use of filters, momentum stacking, betatron cooling, and pickups and kickers. (GHT)

39411 (LBL—7574, pp 82-86) **Proposed p-anti p colliding beam facility at CERN.** Billinge, R. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

A proposed method for obtaining colliding beams of protons and anti protons is presented. The basic scheme consists of directing 26 GeV/c protons from the CERN PS onto a target. The antiprotons produced will be focussed and injected into a fixed-field cooling ring. Each injected pulse undergoes a rapid pre-cooling to reduce its momentum spread, after which it will be deposited by the rf system at the top of the stack. The stack is cooled continuously, both longitudinally and transversely so that particles slowly migrate to the bottom of the stack. The proposed layout is shown. (GHT)

39412 (LBL—7574, pp 93-97) **Stochastic cooling theory.** Sacherer, F.J. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Equations for numerical solution of stochastic cooling are given for open loop and closed loop systems. This complete theory includes the effects of bad mixing. (GHT)

39413 (LBL—7574, pp 98-101) **Relativistic electron cooling for high luminosity proton-anti proton colliding beams at very high energies.** Rubbia, C. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Schemes are proposed whereby a relatively modest device can continuously cool proton and anti proton beams even at ultra-high energies like those in the CERN-SPS (γ = 300) and in the Fermilab-ED (γ = 1000) with improvements of beam stability and luminosity. (GHT)

39414 (LBL—7574, pp 106-111) **Anti p production characteristics and collection systems.** Cline, D. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Results of research into production and collection of anti protons is reviewed. Topics covered include: the production cross-section variation with energy; the production cross-section variation with transverse momenta; and target efficiency and depth of focus of the beam transport. (GHT)

39415 (LBL—7574, pp 123-128) **Are we beating Liouville's theorem.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Using the simple form of the Liouville theorem as it was originally formulated, it is shown how the theorem works with beams of charged particles that are usually accelerated or stored. (GHT)

39416 (LBL—7574, pp 149) **Accommodating stochastic cooling at Fermilab.** McIntyre, P.; Ruggiero, A. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The possibility of using stochastic cooling to augment or replace electron cooling in an ultimate anti proton source at Fermilab has been considered. Unfortunately there is a mismatch between the natural anti proton production cycle time and the cooling time using stochastic cooling. The extent of the mismatch is calculated and a possible way of resolving it is suggested. (GHT)

39417 (LBL—7574, pp 150-154) **Stochastic cooling with noise and good mixing.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Some observations and derivations of the stochastic cooling theory are presented. This work is presented in the time domain as opposed to the frequency domain, and are assumed to be equivalent. (GHT)

39418 (LBL—7574, pp 155-156) **Proton cooling by radiation.** Wilson, R.R. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The theory of synchrotron radiation is considered for protons at energies high enough to be effective in damping orbit oscillations. (GHT)

39419 (LBL—7574, pp 161-164) **Beam stability considerations during electron cooling.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Beam-stability and space-charge limits are calculated for the electron-cooling experiment that is planned for Fermilab at 200 MeV kinetic energy. It is found that the beam can be cooled down only to densities comparable to those presently obtainable with a proton beam circulating in the Booster at 200 MeV. Thus for very small intensities, very small emittances can be expected. If the beam current is raised, the final equilibrium emittance must also increase. These effects do not interfere with the collection of antiprotons because electron cooling makes space for new beam pulses. The beam stability is estimated against well-known theories. (GHT)

39420 (LBL—7574, pp 165) **Antiproton momentum compactor-debuncher linac.** Jones, L.W. (Univ. of Michigan, Ann Arbor). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The momentum acceptance at the Fermilab Booster for 5.18 GeV antiprotons limits the accepted antiproton momentum spread to $\Delta P/P = 3 \times 10^{-3}$. It is noted that a larger momentum spread from an antiproton production target may be accepted if a short linac section is used to give the antiprotons an energy kick following a drift space from their production target, so that their time of arrival at the linac is related to their momentum error. (GHT)

39421 (LBL—7574, pp 166-170) **High-energy electron cooling.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The feasibility of high-energy cooling, especially in the context of an experiment for the Fermilab accelerator Main Ring, is examined with the aim of lengthening the beam lifetime. Although some approximation in the approach cannot be avoided, the primary interest is in a self-consistent solution which takes into account the behavior of the equilibrium of the proton (anti proton) beam as well as the electron beam which is assumed to be circulating in a storage ring. (GHT)

39422 (LBL—7574, pp 325-398) **Collecting anti protons in the Fermilab Booster and very high energy proton-anti proton interactions. Appendix C.** Cline, D.; McIntyre, P.; Mills, F.; Rubbia, C. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

A technique is described for producing an intense beam of antiprotons to be used for very high energy anti p-p colliding beams. The Fermilab Booster is to be used as a collector for antiprotons produced on an external target. The antiprotons are decelerated and transferred to a 200 MeV storage ring (Freezer Ring) and then collapsed in phase space by electron cooling. Repetitive accumulation over 10^4 to 10^5 Booster pulses, acceleration to 8 GeV and injection into the main ring lead to the possibility of anti p-p collisions at several hundred GeV with luminosity in excess of 10^{29} $cm^{-2}sec^{-1}$.

39423 (UCRL—81834) **Progress in space charge lens development.** Lefevre, H.W.; Booth, R. (Oregon Univ., Eugene (USA). Dept. of Physics; California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 3p. (CONF-790327—72). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A number of space charge lens electrode geometries have been studied for use at very high beam currents at low energy, and for precision optics at MeV energies. One such lens mounted very near a Duo-plasmatron extractor delivered a 30-keV beam of H^+ ions through an analyzing magnet at a current of 175 mA for a period of six hours. Another produced a focal spot of diameter 0.2 mm when a 1-cm diameter beam of 1.2-MeV protons was focussed 90 cm from the lens. This paper also describes observations on self-sustaining discharge in the lenses. A very interesting rotation of the lens optic axis about the geometric axis at a frequency near the drift frequency occurs when the vacuum is spoiled by electrode outgassing.

AUXILIARIES AND COMPONENTS

39424 (CONF-771035—P2, pp 649-661) **Microwave generation in the reflex triode.** Brandt, H.E.; Bromborsky, A.; Bruns, H.B.; Kehs, R.A. (Harry Diamond Labs., Adelphi, MD). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

In recent experiments at the Harry Diamond Laboratories and at the Naval Research Laboratory, intense microwave emission has been observed during reflex triode operation. A fully relativistic, time-dependent one-dimensional simulation code, based on the technique formulated by Birdsall and Bridges, was written to investigate the collective electron oscillations and to predict the microwave energy spectral density. Predicted and measured reflex triode microwave energy spectral densities in the X-band region are in reasonable agreement with one another and confirm the validity of the model. Computer experiments indicate that microwave generation could be greatly enhanced by feeding the radiated energy back into the oscillating space-charge cloud.

39425 (LA—7445-C, pp 124-137) **Buncher development for ORIC injection.** Milner, R.; Ziegler, N.F. (Oak Ridge National Lab., TN). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Design and operation of the injection buncher for the Oak Ridge isochronous cyclotron are discussed. Results from the bunching of oxygen ions are presented. (GHT)

ION SOURCES

39426 (CONF-790327—10) **Single-crate stand-alone CAMAC control system for a negative ion source test facility.** Juras, R.C.; Ziegler, N.F. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A single-crate CAMAC system was configured to control a negative ion source development facility at ORNL and control software was written for the crate microcomputer. The software uses inputs from a touch panel and a shaft encoder to control the various operating parameters of the test facility and uses the touch panel to display the operating status. Communication to and from the equipment at ion source potential is accomplished over optical fibers from an ORNL-built CAMAC module. A receiver at ion source potential stores the transmitted data and some of these stored values are then used to control discrete parameters of the ion source (i.e., power supply on or off). Other stored values are sent to a multiplexed digital-to-analog converter to provide analog control signals. A transmitter at ion source potential transmits discrete status information and several channels of analog data from an analog-to-digital converter back to the ground-potential receiver where it is stored to be read and displayed by the software.

39427 (LA—7445-C, pp 175-186) **Operating experience with an 834 Hiconex sputter ion source.** Lund, T.S.; Sondheim, W. (Univ. of Rochester, NY). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Operation of the cesium gun sputter ion source on the University of Rochester Van de Graaff accelerator is described. Beams of BeH, BeOH, Sn, O_2, W, WO, WO_2, and WO_3 are reported. (GHT)

39428 (LA—7445-C, pp 187-198) **Brookhaven terminal ion source.** McKeown, M. (Brookhaven National Lab., Upton, NY). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Operation of a cesium sputter—ion source in the terminal of the MP tandem Van de Graaff of Brookhaven National Laboratory is described. The source configuration is shown, and protective circuitry is discussed. (GHT)

INJECTION AND EXTRACTION SYSTEMS

39429 (BNL—25784) **1.5 GeV/c multiturn shaving extraction and its transport line for the Brookhaven AGS.** Weng, W.T.; Blumberg, L.N.; Gill, E.; Soukas, A.; Witkover, R.L.; Egleman, E.; LoSecco, J.; Sulak, L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790327—1). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A system for fast shaving extraction at 1.5 GeV/c is implemented to extract the circulating beam in five turns. A numerical simulation is first carried out to determine the emittance and the rf structure of the extracted beam. This is followed by several machine study sessions which establish the optimal extraction configuration, confirm the emittance, and modify the transport line for low energy beam. Finally, a one-week run for the Neutrino Oscillation experiment demonstrates that the system is very stable and capable of delivering 7.5×10^{12} p/sec with 70% extraction efficiency and 95% transport efficiency.

39430 (CONF-771035—P2, pp 729-740) **Limiting currents for injection of an unneutralized magnetized relativistic electron beam into a cylindrical drift tube.** Thompson, J.R.; Sloan, M.L. (Austin Research Associates, TX). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Results of an investigation of the steady state injection of a uniform unneutralized, magnetized, relativistic electron beam into a cylindrical drift tube are presented. The space-charge limited current and the asymptotic kinetic energy of electrons on axis are determined both numerically and analytically as a function of the input kinetic energy $(\gamma_0\text{-}1)mc^2$ and the ratio of beam-to-wall radii. A previously cited interpolation formula is obtained in the pencil beam limit, but more accurate limiting current expressions are developed for other cases (such as the fat beam limit) where the interpolation formula is as much as 20% in error. The corresponding axial electron energy is also found to be significantly smaller than the previously cited value of $(\gamma_0/\text{sup } 1/3/\text{-}1)mc^2$ except in the strong pencil beam limit.

39431 (LA—7445-C, pp 113-123) **Principles of pulsing for tandem accelerators.** Liebert, R. (General Ionex, Newburyport, MA). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Design of an ion beam buncher is discussed. Basic considerations of chopper design and location, and buncher operation for a variety of ions are covered. (GHT)

39432 (LA-UR—79-703) **Neutral beam injection for a proton storage ring.** Hudgings, D.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—40). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The spallation neutron source at the Los Alamos Scientific Laboratory is to be upgraded with the addition of a high current Proton Storage Ring (PSR). This paper describes a novel charge changing injection technique that substantially simplifies the ring design. The method consists of converting the 800-MeV negative hydrogen (H^-) ion beam from the linac to a 100% neutral hydrogen (H^0) beam having an acceptable emittance and drifting it directly onto the proton closed orbit in the ring. The neutralization is accomplished by electric field dissociation of the H^- ions.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 39289, 39332, 39333, 39334, 39335, 39336, 39337, 39343, 39377, 39472

39433 (BNL—25311) **MPS configuration and performance characteristics.** Ozaki, S. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 25p. (CONF-780892—1). Dep. NTIS, PC A02/MF A01.

From Bubble chamber symposium; Sandai, Japan (17 Aug 1978).

The Multiparticle Spectrometer Facility at the Brookhaven AGS is described, and some of the experiments run there recently or that are scheduled to run there are discussed. (GHT)

39434 (BNL—25734) **Possibility of acceleration of polarized protons in the Brookhaven AGS.** Crabb, D.G.; Krisch, A.D.; Terwilliger, K.M.; Cork, B.; Courant, E.D.; Feltman, A.; Ruth, R.D.; Parker, E.F.; Ratner, L.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—160). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The unexpected importance of high energy spin effects and the success of the 12 GeV Argonne ZGS in jumping many intrinsic and imperfection depolarizing resonances suggests that polarized proton acceleration should be tried at higher energy. The 1977 Ann Arbor Workshop concluded that it might be possible to jump depolarizing resonances in strong focusing synchrotrons. During the past year we have evaluated the possibility of accelerating polarized protons in the Brookhaven AGS. We found that for about $2 million one could obtain a polarized ion source, fast resonance jumping magnets, and 3 polarimeters which should allow acceleration of 10^{11} to 10^{12} polarized protons to 23 GeV/c with about 70= polarization or to 26 GeV/c with about 50% polarization.

39435 (BNL—25795) **Tests of a new secondary emission chamber at the AGS.** Yamin, P.; Repeta, L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 2p. (CONF-790327—68). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A secondary emission chamber (SEC) has been built using .00025" aluminum foils with a 200A vacuum-deposited silver coating. After baking the assembly, the foils were cleaned with an argon glow discharge. The chamber was then installed in a primary proton beam at the Brookhaven AGS. A difference in sensitivity of 6% was noted between the chamber's two emitter foils. After exposure to a flux of 10^{18} to 10^{19} protons/cm^2, the sensitivity of one of the foils was found to have increased by 0.2% and the other to have decreased by 1.2%. This is substantially better than earlier designs.

39436 (BNL—25796) **High field superconducting beam transport in a BNL primary proton beam.** Allinger, J.; Brown, H.N.; Carroll, A.S.; Danby, G.; DeVito, B.; Glenn, J.W.; Jackson, J.; Keith, W.; Lowenstein, D.; Prodell, A.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—69). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Construction of a slow external beam switchyard at the BNL AGS requires a rapid 20.4° bend in the upstream end of the beam line. Two curved superconducting window dipole magnets, operating at 6.0 T and about 80% of short sample magnetic field, will be utilized with two small superconducting sextupoles to provide the necessary deflection for a 28.5 GeV/c primary proton beam. Because the magnets will operate in a primary proton beam environment, they are designed to absorb large amounts of radiation heating from the beam without quenching. The field quality of the superconducting magnets is extremely good. Computer field calculations indicate a field error, $\Delta B/B_0$, equivalent to $\approx 1 \times 10^{-4}$ up to 75% of the 8.26 cm full aperture diameter in the magnet.

39437 (BNL—25797) **Factors determining the choice of the beam tube material and the vacuum chamber design for a superconducting high energy storage accelerator.** Aggus, J.; Edwards, D. Jr.; Halama, H.J.; Herrera, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—58). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The factors which determine the choice of the material and the basic design for the vacuum chamber of the ISABELLE Colliding Storage Accelerator are reviewed. When the physical, thermal, electrical, and mechanical properties of the bulk material, as well as the various surface characteristics, are considered, it appears that a stainless tube covered with a copper sleeve is the best choice for the chambers in the magnet lattice of the rings. Aluminum is probably the most desirable material for those chambers in the experimental straight sections.

39438 (BNL—25880) **Thermal hydraulics of accelerator breeder systems for regeneration of reactor fuel assemblies.** Yu, W.S.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 36p. (CONF-790423—6). Dep. NTIS, PC A03/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

The following conclusions are obtained with regard to the thermal-hydraulic behavior of the Linear Accelerator Fuel Regenerator for PWR and CANDU fuel: (1) two-phase flow is a feasible coolant option for fuel element heat fluxes up to 1 x PWR (or CANDU) average value, which is the maximum design value for a LAFR; (2) two-phase flow pressure drops are low (typically 10 to 30 psi) and film temperature drops very low (typically ~ 10°F) for PWR fuel, with inlet velocity range (50 to 75 ft/sec). A somewhat higher inlet velocity range (75 to 100 ft/sec) and pressure drop (50 to 100 psi) is necessary for CANDU fuel, however, to prevent dry out.

39439 (CONF-771035—P2) **High power electron and ion beam research and technology.** Nation, J.A.; Sudan, R.N. (eds.). (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies). 1977. 424p. Dep. NTIS, PC A18/MF A01.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Topics covered in volume II include: collective accelerators; microwaves and unneutralized E-beams; technology of high-current E-beam accelerators and laser applications of charged-particle beams. Abstracts of twenty-nine papers from the conference were prepared for the data base in addition to six which appeared previously. (GHT)

39440 (CONF-771035—P2, pp 857-868) **Inductive storage for high power REB accelerators.** Vitkovitsky, I.M.; Conte, D.; Ford, R.D.; Lupton, W.H. (Naval Research Lab., Washington, DC). 1977.

From 2. international topical conference; Ithaca, NY, USA (3 Oct 1977).

Investigation of inductive storage technology for powering 10^{11} to 10^{12} W relativistic electron beam accelerators is presented. Circuits for effective power amplification using inertial energy storage units as current sources for generating high voltage have been analyzed. The analysis, based on using economical, high current, opening switch modules with command triggering capability, indicates that good efficiencies can be obtained. Experimental results supporting the analytical projection are summarized. The experimental results include generation of 300 kV inductive voltage at the output of 85 kJ magnetic storage coil and demonstration of inductive charging of an 8 Ohm water-dielectric pulse line to 500 kV.

39441 (CONF-790327—3) **Holifield Heavy Ion Research Facility. Phase II.** Ball, J.B.; Hudson, E.D.; Lord, R.S.; Johnson, J.W.; Martin, J.A.; McNeilly, G.S.; Milner, W.T.; Mosko, S.W.; Sayer, R.O.; Robinson, R.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The Holifield Heavy Ion Research Facility, with the completion of Phase I in late 1979, will include the Oak Ridge Isochronous Cyclotron (ORIC) and associated research areas, the new 25 MV tandem accelerator with new research areas for tandem beams, and modifications to utilize the ORIC as a booster accelerator. The combination of the tandem and ORIC will provide beam energies of 25 MeV/A for light heavy ions and 6 MeV/A up to A = 160. This paper discusses plans for a Phase II expansion of the facility to include an isochronous cyclotron with superconducting magnet and reconfiguration of the existing research areas and the ORIC vault to handle the higher energy beams from the new cyclotron. The new booster cyclotron is a low-flutter high-spiral design patterned after the MSU K = 800 design, with a central magnetic field of about 5 tesla and an extraction radius of 1 meter. The new beam transport system will incorporate an rf beam-splitter system that will be able to deliver successive beam pulses to two or three experiment areas.

39442 (CONF-790327—8) **Implementation of the ORIC magnetic field measurements.** Cleary, T.P. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The experimental details and methods employed in an extensive remapping of the magnetic field of the Oak Ridge Isochronous Cyclotron (ORIC) were reported previously. The medium- to high-field data (from 12 to 20 kgauss) have been Fourier analyzed and each of the coefficients parameterized in terms of the currents in the main coil, trim, harmonic and valley coils and the average field at each of the radii at which measurements were made. By inclusion of the average field in the formulation, the nonlinear effects of the iron are implicitly taken into account. This procedure has reduced the overall size of the data base by a factor of 100. Synthesis of the field from this parameterization reproduces the absolute field to within 10 gauss and the relative field to within 5 gauss. A field optimization program, which incorporates these results, is currently under development in an effort to enhance the heavy ion acceleration capabilities of the cyclotron and as an aid in the development of new beams.

39443 (CONF-790327—9) **Control system for the Holifield Heavy Ion Research Facility beam buncher.** Ziegler, N.F. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A beam buncher has been developed to produce very short pulses of beam from the 25 MV accelerator for injection into ORIC. The buncher is a two-harmonic double-drift klystron-type operating over a frequency range of 4.5 to 14.5 MHz and has produced 1.1-ns pulse widths of ^{16}O in tests on the ORNL EN tandem accelerator. Both rf voltage on, and relative phase between, the two buncher drift tubes must be accurately controlled to maintain the required narrow pulse width. A control system has been developed which accomplishes these tasks as well as automatic tuning of the buncher resonators, monitoring system parameters, and remote adjustment of various mechanical devices. Input commands and monitoring signals are CAMAC-compatible so that the system can eventually be included in the computer-based control system for the accelerator. In addition to the requirement for a very narrow beam pulse, the pulses must arrive at the ORIC dee gap with precise phasing. A closed-loop control for this task is being constructed using the beam pulse phase detector circuit developed at Argonne National Laboratory.

39444 (COO—4933-1) **Photoneutron target design for fast neutron spectrum measurements.** Bokharee, S.A.; Emmett, R.W.; Becker, M.; Block, R.C.; Harris, D.R.; Malaviya, B.K.; Hayashi, S.A.; Yamamoto, S. (Rensselaer Polytechnic Inst., Troy, NY (USA). Gaerttner LINAC Lab.; Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1979. Contract ET-78-S-02-4933. 7p. (CONF-790602—1). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The potential application of thorium in nuclear fuel cycles has led to a need for improved thorium data for reactor calculations. The measurement of neutron spectra emanating from homogeneous assemblies containing thorium can provide integral data of benchmark quality against which the adequacy of differential nuclear data can be tested. At RPI the thorium integral experiments currently underway utilize a 0.6-m-dia. spherical assembly of thoria which was designed, constructed and originally used in conjunction with the spectrum measurements program of the Research Reactor Institute of Kyoto Univ. (KUR) in Japan. The assembly has been made available on loan to RPI, to extend the measurements to higher energies and to greater resolution with the well-established time-of-flight facilities at the RPI Gaerttner LINAC Laboratory. Previous measurements at KUR on this assembly employed a 5-cm-dia. cylindrical lead target located inside the assembly through a 5-cm-dia. reentrant hole. This target was limited to a maximum of ~ 120 watts of electron beam power and it was not specifically designed to yield an isotropic distribution of emergent neutrons. This paper describes the design and testing of a higher powered target which produces a more isotropic distribution of emergent neutrons.

39445 (DOE/TIC—10045) **Septum magnet coil design principles.** Foss, M.H.; Lari, R.J. (Argonne National Lab., IL (USA)). 4 Jan 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

A guide is presented for the design of the coils of septum magnets using the computer program TRIM. A method is described that eliminated the trial and error procedure and produces a coil design in only 2 TRIM calculations. The first TRIM calculation determines the position of the ampere turns to drive the yoke. The second TRIM calculation verifies the coil design.

39446 (LA-UR—79-463) **Room-temperature cavities for high-beta accelerating structures.** Schriber, S.O. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 23p. (CONF-790143—1). Dep. NTIS, PC A02/MF A01.

From Conference on future possibilities for electron accelerators; Charlottesville, VA, USA (8 Jan 1979).

Properties of several room-temperature cavities for standing-wave linear accelerator structures are discussed. In particular, new results related to the disk-and-washer geometry are presented. Extensive calculations using the computer program SUPERFISH have shown that the $\beta = 1.0$ the effective shunt impedance is at least 20% higher than that of an equivalent LAMPF cavity, while quality factors can be a factor of two higher.

39447 (LA-UR—79-651) **Mechanical technologies for PIGMI.** Hansborough, L.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—26). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

PIGMI (Pion Generator for Medical Irradiations) is a compact linear proton accelerator designed for a hospital environment. The prototype of the low energy section of PIGMI has been designed and is being fabricated at the Los Alamos Scientific Laboratory. It is an accelerator design which makes use of several advanced or innovative technologies. The PIGMI Prototype consists of a 250 keV injector, a double harmonic buncher, a tape-wound 13 KG solenoid magnet, and four accelerator tanks with a total of 63 drift tubes of which 18 contain strong focusing quadrupoles of permanent magnets. The accelerator tanks are mild steel, copper-plated using a bright acid leveling technique. Drift tubes are stainless steel, fabricated using electron beam welding, shaped in a lathe and then copper plated. Drift tubes loaded with permanent magnets are sealed using laser welding. The samarium cobalt magnets are shaped by cutting and grinding techniques developed at Los Alamos.

39448 (LA-UR—79-658) **Initial performance of the PIGMI prototype.** Stovall, J.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—24). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The PIGMI (Pion Generator for Medical Irradiations) program at LASL is an accelerator development program aimed at completing the design of an accelerator suitable for use as a pion generator in a hospital-based radiotherapy program. The major thrust of the program has been the design of a 7 MeV prototype accelerator which emphasizes compactness, economy of construction, and operation and reliability. To achieve these goals the design of the prototype has exploited a number of innovations in proton linac technology. An overview of the program discussing the major innovative features of the prototype is presented. The initial operating experience is discussed and initial performance measurements are presented.

39449 (LA-UR—79-685) **Experimental and calculated rf properties of the disk-and-washer structure.** Potter, J.M.; Schriber, S.O.; Humphry, F.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. (CONF-790327—18). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A detailed study of the disk-and-washer structure using SUPERFISH has shown that the physical geometry can be optimized to make the structure more efficient than previously reported. The calculated ZT^2 is equal to that of an equivalent LAMPF cavity (neglecting any losses associated with the side-coupler slots) for $\beta = 0.6$ and is 30% higher for $\beta = 1.0$. Several techniques for supporting the washer were studied in addition to the conventional "L" supports. Two types of supports, the "TO" that supports two washers from every other disk with a T, and radial supports in the washer plane, improve left-right symmetry and reduce the tuning effort required to achieve a satisfactory field distribution. Effects of these supports on tuning procedures are discussed.

39450 (LA-UR—79-688) **Graphite targets for use in high intensity beams at LAMPF.** Agnew, L.; Baldwin, T.S.; Grishman, D.L.; Holmberg, R.C.; Lambert, J.E.; Lindquist, L.O.; Reiswig, R.D.; Thorn, L.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—14). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Graphite pion production targets are in use at the high intensity 800-MeV proton beam of the Clinton P. Anderson Meson Physics Facility (LAMPF). Radiatively cooled ATJ graphite targets have been used successfully at two target stations at proton currents of 500 μA. A water-cooled pyrolytic graphite target has been developed and put into service at the LAMPF Biomed target station at 400-μA proton current. Mechanical design features and performance data are presented.

39451 (LA-UR—79-689) **Monitor 1979.** Grisham, D.L.; Ekberg, E.L.; Lambert, J.E.; Meyer, R.E.; Stroik, P.J.; Wickham, M.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—22). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The status, improvements, and accomplishments of the Monitor remote-handling system previously reported are updated. It also outlines the goals for the future to improve the efficiency and speed of remote-maintenance operations at the Clinton P. Anderson Meson Physics Facility (LAMPF).

39452 (LA-UR—79-705) **Advances in high-power rf amplifiers.** Tallerico, P.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-790327—21). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Several powerful accelerators and storage rings are being considered that will require tens or even hundreds of megawatts of continuous rf power. The economics of such large machines can be dictated by the cost and efficiency of the rf amplifiers. The overall design and performance of such narrow-band amplifiers, operating in

the 50- to 1500-MHz region, are being theoretically studied as a function of frequency to determine the optimum rf amplifier output power, gain, efficiency, and dc power requirements. The state of the art for three types of amplifiers (gridded tubes, klystrons, and gyrocons) is considered and the development work necessary to improve each is discussed. The gyrocon is a new device, hence its various embodiments are discussed in detail. The Soviet designs are reviewed and the gyrocon's strengths and weaknesses are compared to other types of microwave amplifiers. The primary advantages of the gyrocon are the very large amount of power available from a single device and the excellent efficiency and stable operation. The klystron however, has much greater gain and is simpler mechanically. At very low frequencies, the small size of the gridded tube makes it the optimum choice for all but the most powerful systems.

39453 (LA-UR—79-714) **Pion beam development for the LAMPF biomedical project.** Paciotti, M.; Amols, H.; Bradbury, J.; Rivera, O.; Hogstrom, K.; Smith, A.; Inoue, H.; Laubacher, D.; Sandford, S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—34). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Common to both static and dynamic patient irradiations at the LAMPF linac is the problem of maintaining good quality control of beams form a secondary channel. A major contributor to therapy beam variation has been change in electron contamination due to the change in target geometry and proton beam steering. The electron variation problem is described and a solution is presented that has been realized as a result o a new target geometry that allows some control of the electron fraction. (GHT)

39454 (LA-UR—79-898) **Physics uses of intense proton beams at 10 to 20 GeV.** Nagle, D.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6 p. (CONF-790347—2). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

The physics experimental potential for beams of 10 to 20 GeV protons is discussed. Some specific research fields to utilize a kaon factory are: physics with polarized beams and polarized targets; pion scattering; exotic hadronic states; hypernuclear physics; kaonic atomic x-rays; nuclear scattering with kaons; nuclear spectroscopy with kaons; neutral kaon physics; rare decays of the kaon; antiproton physics; neutrino-electron scattering; and hadronic atoms. (GHT)

39455 (LBL—7574, pp 112-120) **Detectors; relation of detectors to proton-anti proton machines.** Fung, S.; Jones, L.W.; Pondrom, L.; Salvini, G.; Tollestrup, A. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Topics covered include: philosophical considerations and general aspects; relation of detectors to proton-anti proton machines; some scientific apparatuses for proton-anti proton experiments; use of a magnetic field in the detectors; resolution in energy and masses; return to the universal 4 pi detector; and a comment on the future of particle detectors. (GHT)

39456 (LBL—7574, pp 189-324) **Design study of a proton-anti proton colliding beam facility. Appendix B.** 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

During 1976 two working groups examined the technical aspects of injecting antiprotons into the SPS and accelerating them, together with protons, to 270 GeV, the maximum energy at which it can store particles continuously. As a result, an experiment (ICE) on stochastic and electron cooling was initiated, and in parallel, a study group was formed to prepare a detailed design for a proton-anti proton facility, using the SPS as a storage ring. The design is presented. (GHT)

39457 (LBL—8808) **Secondary emission monitors at the Bevatron-Bevalac.** Barale, J.J.; Crebbin, K.C.; Lax, J.W.; Richter, R.M.; Zajec, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979. Contract W-7405-ENG-48. 5p. (CONF-790327—71). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Secondary Emission Monitors (SEM) are used for high intensity, high energy beam fluence monitoring of heavy ions. The improved electronics and autozeroing of background noise has extended the useful factor is capacitive changes between the chamber foils, from acoustic and mechanical vibration. Usable levels are in the 10^4 particles per pulse range for C^6 ions. The secondary electron yield is proportional to $1/\beta^2$. This gives an increase in yield of about a factor of 25 for injection energies over peak energies at the Bevatron. This enhanced yield has been exploited in designing relative intensity and position monitors that give usable signal levels while intercepting only a small percentage of the injected beam. The detector in this case is a wire grid. The output can be: (1) sum proportional to the beam intensity or as a time profile; (2) Split grids for a right-left monitor; (3) single wire scan for a spatial profile. These monitors give usable signals down to a level of 0.01 to 0.1 μA of injected beam.

39458 (LBL—8818) **Precision magnetic measurements by the floating wire analog technique.** Green, M.I.; Dols, C.G.; Henderson, T.F.; Nelson, D.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 5p. (CONF-790327—95). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Two SuperHILAC magnetic spectrometers were calibrated by means of current-carrying, floating wires. An effective radius-of-curvature as a function of single position measurements of magnetic-induction was determined with a probable error of +-0.02% over the range of rigidity: $0.3 \leqq B\ rho \leqq 2.4$ (Tesla-meters). Employed in the calibrations were: optical detectors for determining wire position, an eddy-current jiggler for reducing pulley stiction, a vacuum re-entrant tube for allowing calibration under spectrometer operating conditions, two-axis gradient correction coils for operating an NMR magnetometer in gradients of 70 Gauss/cm, a calculator program for facilitating data collection, and a computer program for data reduction and presentation.

39459 (LBL—8947) **Computed tomographic reconstruction of beam profiles with a multi-wire chamber.** Alonso, J.R.; Tobias, C.A.; Chu, W.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Loma Linda Univ., CA (USA)). Mar 1979. Contract W-7405-ENG-48. 5p. (CONF-790307—92). Dep. NTIS, PC A02/MF A01.

From International conference on fracture mechanics in engineering applications; Bangalore, India (26 Mar 1979).

MEDUSA (MEdical Dose Uniformity SAmpler), a 16 plane multi-wire proportional chamber, has been built to accurately measure beam profiles. The large number of planes allows for reconstruction of highly detailed beam intensity structures by means of Fourier convolution reconstruction techniques. This instrument is being used for verification and tuning of the Bevalac radiotherapy beams, but has potential applications in many beam profile monitoring situations.

39460 (ORNL/TM—6828) **Concept evaluation of a nuclear design for electronuclear fuel production: evaluation of ORNL's proposed TMF—ENFP.** Burns, T.J.; Bartine, D.E.; Renier, J.P. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The use of an external neutron source, generated via an accelerator, represents a potential means for producing the fissile isotopes ^{233}U and ^{239}Pu. One promising accelerator-breeder concept employs a sodium-cooled ternary metal fertile blanket (^{239}Pu, ^{238}U, and ^{232}Th) surrounding a central column of sodium. A preliminary assessment of the neutronic characteristics and the relevant economic parameters for this system, designated the TMF—ENFP (Ternary Metal Fueled ElectroNuclear Fuel Producer) is described here. The rationale for selecting the particular configuration utilized was addressed from the standpoints of fissile production, heat generation, and target interaction. The basic assumption assumed a 300-mA beam of 1-GeV protons from the accelerator. A calculational model of the target blanket assembly was developed which met certain prespecified design limitations. A preliminary assessment of the nuclear performance, thermal-hydraulic, and economic parameters was made. For the latter, the use of the TMF—ENFP in conjunction with the denatured ($^{233}U/^{238}U$) fuel cycle in both PWRs and CANDUs was considered. The basic accelerator-driven blanket concept requires a tradeoff between fissile production and the heat-removal capability. Moreover, the centrally located proton beam results in a significant gradient in the power density (Peak/Average ~ 2). Fissile production of the TMF—ENFP configuration considered was 5.8 kg/day of ^{233}U. Such a production rate would support a maximum of 5.58 GW(e) of denatured PWR capacity [or alternatively 11.58 GW(e) of denatured CANDU capacity]. The cost of the TMF—ENFP/thermal reactor system is judged to be competitive with current—generation LEU—PWRs operating from a > $80/lb U_3O_8 resource base.

39461 (SAND—79-0596C) **Operation of repetitively pulsed 300 kV, 20 kA electron beam diode.** Buttram, M.T. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-790327—73). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Repetitively pulsed diodes will be required for most of the proposed inertially confined fusion systems, yet little information is available on the operation of vacuum beam diodes under repetitive conditions. Most data are relevant to laser exciter/sustainer diodes operating at low current density (< 1 A/cm^2) for long pulses. As

such they are of marginal value for estimating the properties of repetitive high current density diodes such as will be required for particle beam and some gas laser fusion drivers.

39462 (SLAC-PUB—2266) **Trirotron.** Lebacqz, J.V.; Dudas, A.J.; Fowkes, W.R. (Stanford Linear Accelerator Center, CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—81). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A radially directed rotating electron beam can be generated in a circular traveling wave resonator (TWR) sustaining a pure traveling wave. After being accelerated by a dc potential, the beam induces a traveling wave in a concentric output TWR, in which the beam energy is converted to rf with very high efficiency. Results of calculations of drive power and efficiency, as well as special matching and coupling requirements, are reviewed.

39463 **Separated function focusing monochromator system for synchrotron radiation.** Hastings, J.B. (Brookhaven National Lab., Upton, N.Y. (USA)); Kincaid, B.M.; Eisenberger, P. (Bell Labs., Murray Hill, N.J. (USA)). *Nucl. Instrum. Methods;* **152**: No. 1, 167-171(1 Jun 1978).

From International conference on synchrotron radiation instrumentation and new developments; Orsay, France (12 - 14 Sep 1977).

The design and performance of a new, general purpose focusing monochromator system is presented. Such a system is ideally suited to collect, focus, and monochromate the highly directional, broad band synchrotron radiation.

39464 **Strong focus electrostatic lens.** Booth, R. (to Department of Energy). US Patent Application 908,030. 22 May 1978. 9p.

Strong focus electrostatic lens wherein a combination of current-carrying coils and charged electrodes form crossed magnetic and electric fields to focus charged paarticle beams.

39465 **Targets for producing high purity I-123.** Blue, J.W. US Patent 4,088,532. 9 May 1978. Filed date 4 Sep 1973. 7p.

Tellurium powder in improved targets is bombarded with a cyclotron beam to produce Xe-123. Flowing gas streams carry the Xe-123 through one cold trap which removes Xe-123 that subsequently decays to I-123. During this bombardment energy deposition in the target material causes its temperature to rise. Some of the tellurium vaporizes and subsequently condenses on surfaces that are cooler than the vaporization temperature. Provision is made for the repeated bombardment of this condensed tellurium.

STORAGE RINGS

REFER ALSO TO CITATION(S) 39411, 39422, 39432, 39437

39466 (BNL—25733) **Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments.** Edwards, D. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 2p. (CONF-790327—62). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The pressure in both electron and proton storage rings is dependent on the particle wall bombardment molecular desorption rates due in one case (proton storage rings) to ~ keV ions while in the other to ~ 100 eV electrons. Also in order to minimize secondary electron amplification effects in both types of machines the secondary electron emission coefficient should be as low as possible. The above quantities have been measured on Al(6061) and SS(304) materials having had various treatments including a sputter deposition of Ti and TiN in the case of Al. The results indicate for both electron and proton storage rings that SS(304) materials properly prepared have particular advantages over Al considering both molecular desorption yields and secondary electron emission effects.

39467 (BNL—25755) **Correction of the closed orbit and vertical dispersion and the tuning and field correction system in ISABELLE.** Parzen, G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—2). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Each ring in ISABELLE will have 10 separately powered systematic field correction coils to make required corrections which are the same in corresponding magnets around the ring. These corrections include changing the ν-value, shaping the working line in ν-space, correction of field errors due to iron saturation effects, the conductor arrangements, the construction of the coil ends, diamagnetic effects in the superconductor and to rate-dependent induced currents. The twelve insertion quadrupoles in the insertion surrounding each crossing point will each have a quadrupole trim coil. The closed orbit will be controlled by a system of 84 horizontal dipole coils and 90 vertical dipole coils in each ring, each coil being separately powered. This system of dipole coils will also be used to correct the vertical dispersion at the crossing points. Two families of skew quadrupoles per ring will be provided for correction of the coupling between the horizontal and vertical motions. Although there will be 258 separately powered correction coils in each ring.

39468 (BNL—25774) **Design status of the 2.5 GeV National Synchrotron Light Source x-ray ring.** Krinsky, S.; Blumberg, L.; Bittner, J.; Galayda, J.; Heese, R.; Schuchman, J.C.; van Steenbergen, A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—5). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The present state of the design of the 2.5 GeV electron storage ring for the National Synchrotron Light Source is described. This ring will serve as a dedicated source of synchrotron radiation in the wavelength range 0.1 A to 30 A. While maintaining the basic high brigtness features of the eariler developed lattice structure, recent work resulted in a more economical magnet system, is simplified chromaticity corrections, and improved distribution of the X-ray beam lines. In addition, the adequacy of the dynamic aperture for stable betatron oscillations has been verified for a variety of betatron tunes.

39469 (BNL—25783) **Beam transfer from the AGS to ISABELLE.** Weng, W.T.; Brown, H.; Claus, J.; Foelsche, H.; Lee, Y.Y.; Raka, E. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—6). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The ISABELLE design current is built up by repetitive transfer of charge from the AGS. To do this, a momentum stacking method similar to the one used at the ISR has been chosen. The AGS beam bunches are synchronously transferred from the AGS into waiting rf buckets on the injection orbit at the ISA, and then slowly accelerated into the previously established debunched beam stack. This process is repeated until all the available momentum aperture in the ISA is filled up, whereupon the beam stack is rebunched and accelerated to the desired operating energy.

39470 (BNL—25793) **Enhanced resistive wall instability for off-centered beams.** Courant, E.D.; Month, M.; Pellegrini, C.; Wang, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790327—61).

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Beam occupation of a large fraction of the available vacuum chamber, typical of high energy proton storage ring designs, results in an enhancement of the resistive wall instability. The effect is considered for ISABELLE during the current stacking procedure. Results for the coasting stack in its initial phase as well as for the injected bunches are presented.

39471 (BNL—25798) **Status of ISABELLE lattice.** Claus, J.; Cornacchia, M.; Courant, E.D.; Parzen, G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790327—56). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

ISABELLE, a facility for colliding protons with center of mass energies between 60 and 800 GeV, is presently under construction at Brookhaven National Laboratory. The device consists of two identical rings for the accumulation, acceleration and storage of proton beams, shaped and interlaced in the horizontal plane to intersect in six so-called crossing points where the beams that rotate in opposite directions in the two rings are exposed to each other. The overall dimensions of the facility are kept relatively small because advantage is taken of the large fields and gradients that are possible in superconducting magnets; the associated saturation effects in the magnet iron make a separated function lattice practically inevitable. The rings are to be filled from the AGS, using synchronous beam transfer; this forces their circumference to an integer multiple of the rf wavelength in the AGS (=67.26 m). The integer chosen is 57, about the lowest value possible, thus the circumference of each ring is 3833.85 m. The charge in each ring is expected to be about 6.4×10^{14} protons, which requires about 250 AGS charges of 2.75×10^{12} protons per pulse if the injection efficiency is 100%. The actual efficiency is unlikely to be better than 50%, so that in excess of 500 AGS pulses may be needed per ring. The beam is to be accumulated in synchrotron phase space by means of an injection and stacking procedure similar to one developed for the ISR at CERN; this leaves the betatron emittance of the circulating beams

independent of its intensity and equal to that in the AGS just before extraction while its momentum spread increases with intensity.

39472 (BNL—25799) **ISABELLE magnet support and adjustment system.** Buchanan, V.; Kassner, D.; Polk, I. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—67). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The ISABELLE superconducting is supported at the quarter points within a carbon steel vacuum vessel by four fiberglass straps. These are positioned at a small angle to the vertical so that contraction of both the magnet core and the suspension straps do not change the position of the magnet centerline. Two smaller fiberglass straps at each support provide horizontal position location. The fiberglass straps are fabricated of uniaxial epoxy fiberglass tape. Creep tests at room temperature and 1.3 times design load show no extension after one year and there was a factor of safety of 5 in breaking strength. An Engineering Test Model was constructed and cycled to 5°K. Heat leak for the eight straps was less than 0.5 W and position stability was within +-0.005". The vacuum vessel is vertically positioned by means of three jack screws with sliding pads and spherical washers between the top of the jacks and the support boxes. Longitudinal and lateral positioning is done by three horizontal screws at each support box. Three shim plates on the top of the support boxes are used to set the magnetic plane and sockets in two of these are used to set the lateral plane.

39473 (BNL—25822) **Design, construction, and operation update of the ISABELLE ring magnets.** McInturff, A.D.; Bleser, E.; Brown, D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790327—4). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

This report updates the various designs and prototypes tested since the last Conference. Included are the operational data of a subassembly of the old 200 x 200 GeV machine design as well as the latest larger prototype ring magnets with their strong points and shortcomings. The working line coil system design presently seems to be nearly completed, having gone through major revisions to increase its possible operational range. One of the major design goals of the magnet series, that of each unit being able to absorb their own energy, seems to be well in hand. This feature enables the magnet string to be protected without external intervention, i.e., without external energy dump or driving the magnet winding normal by an active external circuit. Simply states, this means that the magnet's L/R time constants during quench are short enough to prevent thermal damage. There are two series of prototypes. The first type is the so called "Standard" which will become the ring magnet for ISABELLE. The second is that in which various characteristics and/or limits of various parameters are explored. Various parameters such as specific heat of the windings, increased metal packing fractions, and resistivity of turns (in the normal state) are bracketed. The 400 x 400 GeV version of ISABELLE requires a cold aperture of 13.09 cm, quadrupole magnetic length of 1.6 m, and dipole length of 4.65 m at a peak dipole field of 5.0 T. Twomachine size dipoles and one quadrupole are being presently tested.

39474 (BNL—25857) **Free electron laser and its possible developments.** Pellegrini. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-790307—70). Dep. NTIS, PC A02/MF A01.

From International conference on fracture mechanics in engineering applications; Bangalore, India (26 Mar 1979).

The basic characteristics of a free electron laser in a storage ring are reviewed. Some of the more recent works and ideas and how performance of the laser might be improved are described.

39475 (LBL—7574) **Proceedings of the workshop on producing high luminosity high energy proton-anti proton collisions.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Fermi National Accelerator Lab., Batavia, IL (USA)). 1978. Contract W-7405-ENG-48. 400p. (CONF-780345—). Dep. NTIS, PC A17/MF A01.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

This workshop was devoted entirely to beam cooling and to high luminosity anti pp storage rings. Abstracts of individual items from the workshop were prepared separately for the data base. (GHT)

39476 (LBL—7574, pp 7-12) **Colliding beams at Fermilab.** Wilson, R.R. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The colliding beam program at the Fermilab accelerator is reviewed. A historical view is given from 1967, and possible future operations are discussed.

39477 (LBL—7574, pp 31-49) **High luminosity anti pp machines: the physics goals.** Cline, D.B. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

High energy anti pp collisions will provide a laboratory to observe the interactions of point-like constituents. With machines of luminosity $> 10^{31}\,cm^{-2}sec^{-1}$ the production rate of the intermediate vector bosons and possibly of Higgs bosons will be adequate. The production of massive vector particles that decay electromagnetically as well as the direct production of dileptons will extend knowledge of the electromagnetic interactions. Several schemes to increase the luminosity of anti pp storage rings are discussed. 5 references.

39478 (LBL—7574, pp 141-148) **Electron beam cooling: prospects of ribbon-type E-beams.** Krienen, F. (CERN, Geneva, Switzerland). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

An electron cooling device is described in which the 100 MeV anti protons concentrate at the lower end of its momentum range. The spot size depends on the electron temperature. (GHT)

39479 (LBL—8887) **PEP II RF system.** Hartwig, E.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 4p. (CONF-790327—87). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

State II of PEP consists of adding a superconducting proton storage ring to the electron-positron ring now completing construction. To obtain the desired luminosity between the tightly bunched electron beam and the protons, the protons will be tightly bunched also. The proton bunch length and the number of bunches imposes unusual requirements on the RF system. Acclerating to full proton energy makes the bunching easier.

39480 (SLAC-PUB—2255) **Modeling a horizontal wiggler in an electron storage ring.** Helm, R.H. (Stanford Linear Accelerator Center, CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—77). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The effects of a wiggler on the beam parameters depend on several integrals involving the machine functions and the field distribution in the wiggler. It is shown that these integrals are separable into sums of products of terms containing only the initial values of the machine functions, and terms containing integrals over the wiggler fields. The field-dependent integrals may be determined by numerical integrations based on measured field distribution. In typical wiggler designs, the energy and excitation dependencies of the integrals may be modeled mathematically by simple power series.

39481 (SLAC-PUB—2258) **Experimental review of beam polarization in high energy e^+e^- storage rings.** Schwitters, R.F. (Stanford Univ., CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 19p. (CONF-781095—6). Dep. NTIS, PC A02/MF A01.

From Symposium on high energy physics; Argonne, IL, USA (26 Oct 1978).

Information that is provided by beam polarization in high energy e^+e^- interactions, how polarized beams are produced, the experimental evidence for radiative beam polarization, and the results which have been obtained to date using polarized beams are reviewed. Prospects for beam polarization experiments in future generations of storage rings are discussed.

39482 (SLAC-PUB—2262) **Properties of a linac-storage ring stretcher system.** Loew, G.A. (Stanford Linear Accelerator Center, CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 27p. (CONF-790143—2). Dep. NTIS, PC A03/MF A01.

From Conference on future possibilities for electron accelerators; Charlottesville, VA, USA (8 Jan 1979).

Some of the design characteristics and costs of a matched system comprising a pulsed linac and a storage ring to be used as a beam stretcher are discussed. The goal is to obtain a 2 GeV, 0.1 mA quasi-continuous stream of electrons. Within this goal, some optimization criteria will be examined and some technological difficulties will be indicated.

39483 (SLAC-PUB—2265) **Proposed orbit and vertical dispersion correction system for PEP.** Close, E.; Cornacchia, M.; King, A.; Lee, M.J. (Stanford Linear Accelerator Center, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—85). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The scheme for minimization of the rms orbit errors in ISR and SPEAR will be used to correct the closed orbit errors in PEP. The effectiveness of this scheme has been studied for some alignment and field errors in the PEP magnets and position monitors. It has been found for orbit correction system in PEP consisting of 48 correctors and 96 monitors, both horizontal and vertical orbits can be kept below 0.5 mm rms values even allowing for a position monitor alignment error of 0.5 mm rms. This method of correction has also been found to be usable to reduce the rms value of the vertical dispersion without appreciably affecting the corrected orbits. The result of this study is presented.

39484 (SLAC-PUB—2267) **Longitudinal feedback system for PEP.** Allen, M.A.; Cornacchia, M.; Millich, A. (Stanford Linear Accelerator Center, CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 4p. (CONF-790327—79). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Whether the wide bandwidth longitudinal feedback system described in this paper is made to act on the individual modes in frequency domain or on the individual bunches in time domain, it represents a clean and efficient way of damping the longitudinal oscillations without influencing other beam parameters such as bunch shape or synchrotron frequency distribution. The frequency domain feedback presents the advantage of providing information on which modes are unstable and on their risetimes, which may be helpful in locating dangerous resonators in the ring.

39485 (SLAC-PUB—2270) **Chromatic corrections for large storage rings.** Servranckx, R.V.; Brown, K.L. (Saskatchewan Univ., Saskatoon (Canada); Stanford Linear Accelerator Center, CA (USA)). Feb 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—80). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The use of achromat concept (1) to facilitate chromatic corrections in large storage rings is illustrated. The example given in this report is a lattice for a 75 GeV/c ring with six interaction regions having a beta x = 1.6 m, a beta y = 0.1 m and a luminosity of 1.4 10^{32} $cm^{-2}s^{-1}$. The chromatic corrections are done with four families of sextupoles, two for each transverse plane, the strengths of which are determined by the solution of four linear equations in four unknowns. The basic simplicity of the method allows on-line control of the sextupole adjustments.

39486 **Performance of vacuum components operating at 1 x 10^{-11} Torr.** Halama, H.J. (Brookhaven National Laboratory Upton, New York 11973). *J. Vac. Sci. Technol.;* 16: No. 2, 717-719(Mar 1979).

The Intersecting Storage Accelerator (ISABELLE) consists of two rings having a circumference of 3.8 km each. The vacuum system uses an 8.8-cm circular chamber maintained at 1 x 10^{-11} Torr by a combination of Ti sublimation and 30-l sec^{-1} ion pumps placed at 5-m intervals. Several experimental setups which simulate sections of ISABELLE have been constructed to study the behavior of stainless steel, aluminum, H_2—Ti system, and ion pumps at low pressures (< or = 1 x 10^{-11} Torr). In this paper we will summarize the results of our measurements on (1) total outgassing of 304 stainless and 6061 aluminum, (2) hydrogen pumping speed, ultimate pressure, and sorbing capacity of titanium films as a function of surface coverage, H_2 input flux and surface preparation, (3) hydrogen, methane, helium, and argon pumping speeds of ion pumps as a function of pressure, and (4) reemission of gases from ion pumps.

INSTRUMENTATION

39487 (DIB—78-12-501) **Laboratory instruments, (Brazil). Foreign market survey report.** (Trade Center, Sao Paulo (Brazil)). Jun 1978. 100p. Domestic and International Business Administration, Washington, DC.

The market research was undertaken to study the present and potential US share of the market in Brazil for laboratory instruments; to examine growth trends in Brazilian end-user industries over the next few years; to identify specific product categories that offer the most promising export potential for US companies; and to provide basic data which will assist US suppliers in determining current and potential sales and marketing opportunities. The trade promotional and marketing techniques were also reviewed.

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 38288, 38733, 38737, 38828, 39177, 39457, 39681, 39943

39488 (IAEA—208(Vol.2), pp 321-326) **Progress report on detector cross section benchmark measurements in the TAPIRO reactor.** Martini, M.; Moioli, P.; Sirito, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). 1978.

From Consultants meeting on integral cross section measurements in standard neutron fields; Vienna, Austria (15 Nov 1976).

A program of irradiation of activation detectors aimed to improving the knowledge of their cross sections in under way in the core and reflector of the TAPIRO reactor. This program follows the recommendations of the first IAEA Consultants' Meeting on detector cross sections, where TAPIRO was identified as a candidate benchmark spectrum for dosimetry reactions. This report presents a comparison between activation measurements and predictions based on differential data for Category 1 and Category 2 reactions, some preliminary conclusions and the future program.

39489 **In-place testing of monitors for airborne reactor effluents.** Stroem, L.H.; Hesboel, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)). pp 319-329 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The performance of installed two-stage sampling systems for stack effluents has been investigated. The primary circuit comprises sampling nozzles in the stack and sample transport line. Sampling errors and particle deposition is shown to be minimized if the conduit diameter is large and the air flow suitably chosen. The secondary circuit takes a subsample from the primary circuit. It consists of a nozzle, a particle filter, an iodine adsorber, and a gas monitor. The sampling system is tested with respect to representativeness of sampling and to losses in the sample transport line. Representativeness is checked by introducing non-depositing methyl iodide, tagged with iodine-131, into a ventilation duct. It is sampled in the stack, and at the regular sample collection point in the secondary circuit. The representativeness is usually good. Tests of sampling line losses are made with elemental iodine and particles. Elemental iodine deposits are introduced only to a small extent in the primary circuit. The particles of a special test aerosol are transmitted with poor efficiency above 10μm. Iodine in effluent air from a reactor at operation has been observed to consist of mainly methyl iodide. The particulate radioactivity was concentrated on particles smaller than 4μm.

39490 **Coded aperture imaging with uniformly redundant arrays.** Fenimore, E.E.; Cannon, T.M. (to DOE). US Patent Application 902,183. 2 May 1978. 17p.

A system utilizing uniformly redundant arrays to image non-focusable radiation. The uniformly redundant array is used in conjunction with a balanced correlation technique to provide a system with no artifacts such that virtually limitless signal-to-noise ratio is obtained with high transmission characteristics. Additionally, the array is mosaicked to reduce required detector size over conventional array detectors.

39491 **Detektory dyla vnutrireaktornykh izmerenil energovydeleniya. (Detectors for in-reactor measurement of energy release).** Mitel'man, M.G.; Dubovskii, B.G.; Lyubchenko, V.F.; Rozenblyum, N.D. Moscow, USSR; Atomizdat (1977). 152p.

A discussion is offered of detectors for in-reactor measurements of energy release. An examination is made of the basic means of controlling energy release. The neutron method was shown to be optimal for the operative control of energy release. A detailed examination is made of ionization, calorimetric, activational, and charge detectors. Particular attention is given to ionization and charge methods of measurement since the calorimetric and activational methods are not being widely used for the operative control of energy release. The operational theory of direct charge detectors is given, and substantiation is offered for the principles of their design and use. A description is given of specific systems for the in-reactor control of energy release. The book is intended for engineering - technical personnel engaged in the design and operation of detectors and systems of in-reactor control of energy release as well as for students at institutions of higher learning - future engineers for nuclear power plants. 127 references, 49 figures, 11 tables.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 38735

39492 (DP—1501) **Nuclear incident monitor.** Phillips, T.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jan 1979. Contract EY-76-C-09-0001. 46p. Dep. NTIS, PC A03/MF A01.

This report describes an improved instrument to detect radiation that would be emitted by the accidental assembly of a critical mass of fissionable material. The instrument is a solid-state model designed to supersede a vacuum-tube-circuit model that has been in use for several years. The new instrument provides audible and visible alarms within 4 seconds after exposure to gamma radiation exceeding 1 R/hr. The instrument alarms within 0.3 second after exposure to a 50 microsecond burst of radiation that induces a dose of 0.6 mR.

39493 (N—78-27965) **Passive particle dosimetry. Final report, 17 November 1970—30 June 1977.** Childs, C.B. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics and Astronomy). 30 Jun 1977. Contract NAS8-26601. 71p. NTIS PC A04/MF A01.

Present methods of dosimetry are reviewed with emphasis on the processes using silver chloride crystals for ionizing particle dosimetry. Differences between the ability of various crystals to record ionizing particle paths are directly related to impurities in the range of a few ppm (parts per million). To understand the roles of these impurities in the process, a method for consistent production of high purity silver chloride, and silver bromide was developed which yields silver halides with detectable impurity content less than 1 ppm. This high purity silver chloride was used in growing crystals with controlled doping. Crystals were grown by both the Czochalski method and the Bridgman method, and the Bridgman grown crystals were used for the experiments discussed. The distribution coefficients of ten divalent cations were determined for the Bridgman crystals. The best dosimeters were made with silver chloride crystals containing 5 to 10 ppm of lead; other impurities tested did not produce proper dosimeters.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 39885, 39942

39494 (LBL—7294) **Noise considerations in millimeter-wave spectrometers.** Zoellner, W.D.; Kolbe, W.F.; Leskovar, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

An improved version of a microwave spectrometer operating in the vicinity of 70 GHz is described. The spectrometer, which incorporates a Fabry-Perot resonator and superheterodyne detection for high sensitivity is designed for the detection of gaseous pollutants and other atmospheric constituents. The instrument is capable of detecting polar molecules with absorption coefficients as small as 2 x 10^{-9} cm^{-1}. For sulphur dioxide diluted in air, this sensitivity corresponds to a detection limit of 1.2 ppm without preconcentration and with a time constant of 1 second. Measurements and analysis of the noise contributions limiting the sentivity are presented.

39495 **Fine gamma spectrometry and release measurements.** Bovard, P.; Philippot, J.Cl. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). pp 331-344 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978). (In French)

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The growing number of nuclear facilities and a stricter interpretation of the fundamentals of radiological protection create an ever greater need for more thorough knowledge of releases to the environment. The measurement of releases and effluents involves study of a fairly large mixture of radionuclides. The methods of processing and interpreting Ge(Li) spectra that are described prove highly effective whenever the spectral topology is complex. The data obtained on the composition of nuclide mixtures can be very useful in the event of disputes or litigation. The four stages of metrology involved are discussed, namely measurement, spectral processing, exact definition of transition energies, and final interpretation. Particular stress is placed on the originality of the energy calibration procedure, which avoids the use of an external standard and is based on nuclear equations relating the spectral line energies; very high line definition accuracy is obtained in this way (better than 100eV on average for all the spectral lines present). Some examples of the technique used are given but no details are presented of the conditions and quality of sampling, or the implications for radiological protection of their results.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 39435

RADIOMETRIC INSTRUMENTS

39496 (AD-A—058366) **Multi-ray ablation sensor development program. Final report, 2 June 1975—15 December 1976.** Moody, H.L. (Prototype Development Associates, Inc., Santa Ana, CA (USA)). Apr 1977. Contracts DNA001-75-C-0315;DNA001-76-C-0140. 45p. NTIS PC A03/MF A01.

This report documents the design analyses and test results that were performed in the development of a Multi-Ray Ablation Sensor. The sensor was designed to measure nosetip ablation along nine individual rays with a single photon counting tube (Digicon tube). The sensor measures ablation by measuring the change in gamma-ray activity of radioactive sources located in the nosetip. Nine CsI scintillators convert the incident gamma-rays into photons (light) which are coupled to the photon counting tube with flexible fiber optic light guides. The light guides are positioned on the Digicon tube's photocathode so that the photoelectrons generated by light guide photons are electrostatically focused to a corresponding diode on the anode end of the tube. The nine light guide images on the photocathode are focused, one-to-one, on a corresponding array of diodes. The photoelectrons are accelerated and focused with -15 kV and an electrostatic lens. The signal outputs from the diodes are amplified and shaped for imput into conventional reentry vehicle telemetry interface electronics.

39497 (PB—285966) **Development of a device for continuous automatic monitoring of consolidation of fresh concrete. Final report.** Lee, P.L.; Eggert, G.J. (Rexnord, Inc., Milwaukee, WI (USA)). 3 Mar 1978. Contract DOT-FH-11-8588. 104p. NTIS PC A06/MF A01.

Quality of portland cement concrete can be increased if water/cement ratios are reduced; however, this increase is only achieved if concrete is adequately consolidated. This study was conducted to develop a device to permit continuous automatic monitoring of the degree of consolidation during pavement construction. A literature search identified several candidate techniques, the most feasible being a nuclear backscatter technique to measure concrete density. A prototype instrument was developed with a 500mCi source of Cesium (137) and a sodium iodide/photomultiplier sensing unit. The sensor head is located 1 inch (25.4 mm) above the concrete. It is moved back and forth across the width of the pavement by a traversing mechanism mounted to the back of a slipform paver. Density is recorded on chart paper. The CMD (Consolidation Monitoring Device) is capable of sensing and displaying changes in density while traversing over the pavement surface at 17 fpm (0.086 m/s). It can duplicate core density measurements within a + or -2-1 pcf (+ or -36 kg cu m) confidence range (95% confidence limits).

39498 (UCRL—52657) **X-ray microdensitometer (XRPD) performance characteristics.** Taylor, G.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jan 1979. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

The Nondestructive Evaluation Section of Lawrence Livermore Laboratory (LLL) has been using a computer-controlled microdensitometer (XRPD) to make dimensional measurements on radiographs. The instrument was built to scan with a single round aperture. Previous studies of its performance indicated that, because of problems such as radiation scatter and electronic and film grain noise, its applicability was limited. To overcome some of these problems, the XRPD was modified by the installation of a mechanism that positions any of five rectangular, as well as one round, apertures for scanning. The performance of the instrument after modification was analyzed. In particular, the line-spread function and noise were measured for each aperture. An equation relating the XRPD output and film density was also derived for the operational domain of the instrument. The results indicate that the XRPD performance - and its potential for use in the aerospace, weapons, and nuclear reactor industries - is improved as expected.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 39338

39499 (AD-A—058093) **Comparison study of the five transistor-transistor-logic (TTL) families and emitter coupled logic (ECL). Final report.** Knoll, M.G. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). May 1978. 93p. NTIS PC A05/MF A01.

This report describes the radiation test response of the five transistor-transistor-logic (TTL) technologies and the emitter-coupled-logic (ECL) technology. The five TTL technologies evaluated were Standard, High Speed, Low Power, Low Power Schottky, and Schottky. Quad dual input NAND (TTL) or NOR (ECL) gates and

dual D flip-flops from each technology were tested. The devices were characterized for gamma dose-rate logic upset, total gamma dose survivability, and neutron fluence survivability. The data has been analyzed to provide a comparison of each logic technology's radiation response. (Author)

39500 (AD-A—058360) **Technology assessment and radiation effects characterization of Integrated Injection Logic. Final report, July—September 1976.** Pease, R.L.; Raymond, J.P. (Naval Weapons Support Center, Crane, IN (USA)). Apr 1977. Contract DNA-MIPR-7T-549. 150p. NTIS PC A07/MF A01.

Integrated Injection Logic (I2L) has emerged as a bipolar LSI technology which offers high packing density, low power dissipation, reasonable speed and simplicity in processing. In an isolated form I2L can be incorporated on the same chip with linear devices and/or T2L or ECL input/output buffering. Another feature of I2L is the wide range of power and hence speed over which circuits may be operated. The simple double-diffused form of I2L using lateral pnp transistor injectors has limited speed capability which makes it somewhat unattractive for LSI computer applications. Therefore many second generation forms of I2L have emerged, mainly to increase speed but also to further increase packing density and reduce power. Early radiation effects characterization studies on first generation I2L indicated that both the neutron and total dose failure levels of I2L is substantially lower than other bipolar technologies. The changes incorporated into the second generation I2L processes have, for the most part greatly increased the neutron and total dose failure levels based on test results presented herein. This report presents a technology assessment of I2L including a discussion of the various second generation processes and commercial product developments by U.S. Companies. An evaluation of radiation effects on first and second generation I2L is presented along with neutron, total dose and dose rate tests results on various I2L test structures and devices.

39501 (AD-A—058404) **EMP, lightning, and power transients: their threat and relationship to future EMP standards. Technical note.** Stansberry, C.L. (Defense Communications Engineering Center, Reston, VA (USA)). Nov 1977. 41p. NTIS PC A03/MF A01.

A general description of high-altitude EMP phenomena is given, as well as a characterization of the EMP radiated field in relation to worst-on-worst case parameters. EMP effects on electronics are compared with those of lightning, since lightning produces similar effects. Power line transients are also discussed. The use of lightning and power line transient protection specifications, with modifications, for developing EMP protection specifications is proposed. This document is one of a series concerning Electromagnetic Pulse effects on communication systems. The Defense Communications Engineering Center is preparing this document in response to tasking received from the Manager, National Communications System (NCS). The purpose of this series is to provide information on the subject of EMP effects and the vulnerability of existing communication assets of the Defense Communications System which can form the basis for the development of Federal Telecommunication Standards by the NCS. (Author)

39502 (AD-A—059446) **Radiation effects in satellite cables. Final report 1 Apr 77-31 Mar 78.** Wilkenfeld, J.M.; Leadon, R.E.; Mallon, C.E. (IRT Corp., San Diego, CA (USA)). Apr 1978. Contract DAAG39-76-C-0089. 193p. NTIS PC A09/MF A01.

A combined experimental and analytical study was made of the mechanisms which determine the response of satellite cables to x-rays. Parameters investigated include gaps, with and without trapped air, polymer type, stored charge effects introduced by manufacturing or handling, trapping of space electrons in the dielectric, radiation conductivity, sample-to-sample and manufacturer-to-manufacturer variations, and dose effects. It was found that the principal mechanism enhancing response was the presence of gaps between conductors and dielectrics which are naturally present in braided shield cables and can be introduced by bending in semirigids. The presence of stored charge was less significant. An equilibrium distribution of trapped electrons will be built up in a period of about one-half hour for the artificial trapped environment and in about 20 days in the natural space environment, which will obliterate any previously stored charge. The so-called first pulse anomaly will occur only when one has a cable containing air filled gaps. In this case, the first shot rather than the nth shot response will be most typical of cable behavior. (Author)

39503 (N—78-30544) **Radiation effects. Engineering handbook (methods of improving the radiation tolerance of electronics in space vehicles). Final report.** Holmes-siedle, A.; Freeman, R. (Fulmer Research Inst. Ltd., Stoke Poges (UK)). Apr 1978. Contract ESTEC-2871/76-NL-HP. 482p. NTIS PC A21/MF A01.

Space radiation effects in electronic subsystems are discussed. Useful data from a wide range of sources are presented and methods which have been newly developed to provide engineering solutions to the problem of degradation of devices in space are described. The new developments include a simple model for analyzing space-charge buildup in MOS devices, a ranking scheme for CMOS - LSI circuits and improved dose transmission curves and tradeoff curves for spacecraft life against shield weight. A complete analysis of a piece of spacecraft equipment is given. Recommendations for future progress in hardness engineering are made.

39504 **Optical Cerenkov radiation from microscopic $BaSO_4$ grains.** Ahlen, S.P.; Salamon, M.H. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., A;* **19**: No. 3, 1084-1088(Mar 1979).

In the analysis of an experiment to determine the response of scintillators to relativistic heavy ions, we have discovered that the $BaSO_4$ grains (radius $\sim 0.5\ \mu m$), which constitute the highly reflective interior surface of our light-integration box, emit Cerenkov radiation with an index of refraction intermediate to that of crystalline $BaSO_4$ and to that of the air-crystal volume-averaged reflective coating. The small amount of radiation emitted below threshold ($\sim$ 2% of the $\beta = 1$ signal) is consistent with the expected level due to Cerenkov emitting delta rays and/or to diffraction radiation with no residual scintillation.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 38292, 38794, 39061, 39293, 39649, 40022

39505 (IDO—1702-T1) **Progress report.** (Westinghouse Electric Corp., Boulder, CO (USA)). Nov 1978. Contract ET-78-C-07-1702. 106p. Dep. NTIS, PC A06/MF A01.

Progress in a research program to develop a cost effective, highly flexible, portable controlled source electromagnetic survey system is discussed. The design of the receiver, transmitter, and associated equipment is described in detail.

39506 (N—78-28429) **Oxide thickness monitor.** Grindrod, A. (Central Electricity Generating Board, London (UK)). Apr 1977. 6p. NTIS PC A02/MF A01.

A device to monitor the progression of oxide build-up on mild steel nuclear reactor structures is presented. The measuring probe consists of a single point, ferrite cored sensing coil, which is excited into oscillation by a simple transistorized oscillator. The oscillator output frequency is fed by a buffer amplifier to a standard frequency meter. In-pile off-load use with remote manipulation can be applied.

39507 (SAND—78-1342) **In Situ Environmental Sampler (IES): descriptive analysis and operating procedures.** Gustke, F.R. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 109p. Dep. NTIS, PC A06/MF A01.

The In Situ Environmental Sampler is a unique, self-contained, portable, analog tape-recording system. It was designed to record sample data on environments encountered during transportation. This highly versatile, rugged instrument will record in situ up to 14 channels of data, along with IRIG time and voice, with a maximum frequency response of dc to 5 kHz at tape speeds from 3-3/4 to 15 inches per second. This document describes the system and provides operating procedures for its use.

39508 (UCRL—52000-79-3, pp 17-24) **Measuring velocities by laser Doppler interferometry.** Mar 1979.

In Energy and technology review.

The advanced development of two optical velocimeters, the VISAR (velocity interferometer system for any reflector) and the Fabry—Perot systems, that greatly increase the sensitivity and resolution of measurements of shock and particle velocities is described. Both operate by measuring the Doppler shift in the frequency of light reflected from the moving body. In either case the system output produces velocity information directly, and this information can then be integrated to determine the position at any time. The VISAR output is recorded on fast oscilloscopes that can be set to observe different portions of the velocity history. The Fabry—Perot system has less flexibility, sensitivity, and time resolution than the VISAR, but its output is recorded directly on photographic film and is much simpler to analyze. Both systems are compatible with most of our other diagnostics and measure velocities to about 1% accuracy with time resolutions of a few nanoseconds. They can record velocity features over distances as small as 2.5 μm even though the interferometers may be located over 30 m from the test object.

39509 (UCRL—82358) **Rupture-safe pressure transducers.** Holten, D.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1979. Contract W-7405-ENG-48. 6p. (CONF-7811123—1). Dep. NTIS, PC A02/MF A01.

From 35. DAMSUL committee meeting; Aiken, SC, USA (17 Nov 1978).

The design, fabrication and testing of a rupture-safe transducer for measuring gas pressures in a manned-area field environment are described. (LCL)

39510 (Y/DA—7109) **Microinterferometer transducer.** Corey, H.S. (Oak Ridge Y-12 Plant, TN (USA)). Aug 1977. Contract W-7405-ENG-26. 11p. (CONF-770844—6). Dep. NTIS, PC A02/MF A01.

From International optical computing conference; San Diego, CA, USA (25 Aug 1977).

Portions of document are illegible.

An air-bearing microinterferometer transducer is being developed to provide for increased accuracy, range, and linearity over conventional linear variable differential transformer (LVDT) transducers. The conventional LVDT's are used on multiple-probe sweep gauges to measure deviation from true surfaces to revolution. These LVDT transducers are null devices, and their high accuracy deteriorates rapidly as they move from zero setting. It is desirable to have a transducer with extended range to measure parts that deviate from conventional paths. The length-measuring interferometer is a well-established inspection device. However, constructing a microinterferometer that will fit inside a conventional 1/2-inch-OD transducer housing is a formidable task. Departure from the conventional interferometer construction is required. It will be necessary to transmit the laser beam into the microinterferometer with a self-focusing fiber optic cable. Miniature glassware has been obtained and a microinterferometer constructed inside an 0.315-inch-ID transducer. Fringes have been obtained by directing a laser beam into the transducer housing.

39511 **Experimental determination of probe-length requirements for studies of the turbulent wake behind a cylinder.** Sheih, C.M.; Finnigan, J.J.; Bradley, E.F.; Mulhearn, P.J. (Radiological and Environmental Research Division, Argonne National Laboratory, Argonne, Illinois 60439). *Rev. Sci. Instrum.;* **50**: No. 5, 528-531(May 1979).

The attenuation of turbulence and mean velocity signals due to the line averaging imposed by hot wires when used in the wake of an isolated circular cylinder has been investigated in a wind tunnel by measurements using several choices of hot-wire length, cylinder diameter, and freestream mean velocity. The results are presented graphically in order to provide a practical method for determining attenuation of the turbulence and mean velocity signals obtained in a wake. The length scale of the wake can be defined as L=0.6[(x-x/sub o/) d]/sup 1/2/, where x is the downstream distance from the cylinder, d is the cylinder diameter, and x/sub o/=25d. For all the wires tested, the attenuation of the measured turbulence signal is limited to within 5% only if the wire length is smaller than 0.1 L. For a wire normal to the cylinder and cross wind, the attenuation of the signal of the mean velocity-defect factor, expressed as (1-u/u/sub infinity/), where u and u/sub infinity/ are local and free-stream velocities, respectively, is less than 5% only if the wire is less than 0.5 L in length.

39512 **Apparatus for sectioning diffusion specimens in liquid nitrogen.** Weil, R.; Lazarus, D.; Witt, F. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Rev. Sci. Instrum.;* **50**: No. 5, 642-644(May 1979).

Details are given on the design and operation of an apparatus which enables sectioning of samples in a liquid nitrogen bath. The sectioning of samples, in which a radioactive tracer has been diffused, is made by abrasion.

39513 **Theoretical and experimental study of the dynamic behavior of a nonlinear Fabry-Perot interferrometer.** Bischofberger, T.; Shen, Y.R. (Physics Department, University of California, Berkeley, California 94720). *Phys. Rev., A;* **19**: No. 3, 1169-1176(Mar 1979).

We have studied theoretically and experimentally the dynamic behavior of a nonlinear Fabry-Perot interferrometer filled with a Kerr medium. The Fabry-Perot responses ranging from extremely transient to quasi-steady-state in various modes of operation are considered. The experimental results are in excellent agreement with theory. It is shown that the quasi-steady-state operation requires not only a medium response time much smaller than the cavity round-trip time, but also a characteristic time of the input intensity variation several hundred times larger than the cavity round-trip time. Even in the quasi-steady-state limit, optical switching is often featured by overshoot and ringing after switching. The switching speed is limited by the cavity buildup time.

39514 **Quantitative surface topography determination by Nomarski reflection microscopy I. Theory.** Lessor, D.L.; Hartman, J.S.; Gordon, R.L. (Battelle-Northwest, Richland, Washington). *J. Opt. Soc. Am.;* **69**: No. 2, 357-366(Feb 1979).

The Nomarksi differential interference contrast microscope is examined as a tool for determination of metallic mirror surface topography. This discussion includes the development of an optical model for the Nomarski system, an examination of the key results of the model's application to sloped sample surfaces, and recommended procedures for implementation. The functional relationship is developed between image intensity and the component of surface slope along the Nomarski shear direction, the fixed parameters in the Nimarksi system, and the adjustable phase shifts related to Nomarski prism position. Equations are also developed to allow the determination of surface slope from relative image intensity when sample reflectively is uniform and slopes are small.

WELL LOGGING INSTRUMENTATION

39515 **Determining the composition of sand-clay soils from polarization potentials and gamma logging.** Nekrasov, S.A.; Nikashin, E.S. *Razved. Geofiz.;* No. 72, 156-160(1976). (In Russian).

A justification is advanced for the possibility of determining the sand, silt, and clay fractions of sandy-clayey ores from polarization potentials and gamma logging data. It is shown that there is a relation between the relative amplitude of the polarization potentials and the sand content. Concrete examples of interpretation are presented on deposits from the Moscow and Baltic syneclises.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

39516 (LA—7817-MS(Vol.2)) **M-3 Series on Detonation Science. II. One-dimensional flow.** Fickett, W. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

The M-3 Series on Detonation Science consists of lectures on various topics in detonation theory and explosives research. The plan is to have each set of lectures accompanied by notes in the form of a LAMS report. The first set of lectures, by W.C. Davis, offered an overview; the report for these has not been written. The second set, for which this report constitutes the notes, is an introduction to one-dimensional nonreactive flow. The plan of attack is to, in effect, take the equations apart and put them back together again, adding complications one by one as the reassembly proceeds.

39517 (MHSMP—79-8) **Mechanical properties of LX-10-1 evaluated with the diametric disc test.** Johnson, H.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1979. Contract AC04-76DP00487. 14p. Dep. NTIS, PC A02/MF A01.

The mechanical properties of two Holston lots of LX-10-1 were determined using the diametric disc test formerly known as the indirect tension test. A portion of the diametric disc specimens was machines from isostatic pressings and a second group was pressed-to-shape. Both types of fabricated discs were included in the experiment to establish a relationship of measured disadvantages in explosives testing. The machined discs yeilded an average stress-strain failure slightly higher than the pressed-to-shape disc specimens. Fabrication specification problems encountered with the finished pressed-to-shape disc specimens are being investigated at the present time.

39518 (SAND—78-1731C) **Development of a unique pyrotechnic actuator.** Ballard, C.P.; Steele, B.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 38p. (CONF-790207—5). Dep. NTIS, PC A03/MF A01.

From 10. symposium on explosives and pyrotechnics; San Francisco, CA, USA (14 Feb 1979).

A pyrotechnic actuator has been developed utilizing new design concepts and materials. The new design features include a non-oriented connector, an electrostatic shield for safety, an output-end seal to eliminate initial free volume, and a retaining washer to prevent movement of the pyrotechnic during exposure to high G loads and thermal cycling. New materials in the actuator include a titanium subhydride/potassium perchlorate pyrotechnic for reduced spark sensitivity and a moldable baria/lithia/silica glass ceramic insulator for economy and high pressure burst strength. The glass ceramic has been specially formulated to have a thermal expansion coefficient which minimizes residual seal stress and permits greater actuator design flexibility.

39519 (SAND—79-0027) **Pyrotechnic output of TiH/sub x//$CKlO_4$ actuators. IV. Modelling of TiH/sub x//$KClO_4$ actuator pyrotechnic output.** Lieberman, M.L.; Benzley, S.E. (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

Pyrotechnic output generated by TiH/sub x//$KClO_4$ loaded actuators has been modelled through an analysis of the applicable

forces and utilization of relevant VISAR and load cell data. The assumption of a linearly decreasing force—time relationship yields calculated piston velocity and displacement values that are in good agreement with those obtained from VISAR measurements. The resultant gas pressure versus volume values are compared with those obtained experimentally and differences due to the limitations of the model are considered in terms of the physical phenomena. Modelling of load cell output test results have been performed by combining the force—time relationship of the piston alone with that measured in the load cell test. Good agreement with other measured parameters is obtained by limiting the decrease of force on the piston and utilizing an effective piston-crush cone separation distance somewhat greater than the experimental value. These values are shown to be consistent with the physical phenomena. In addition, it is shown that the use of an effective projectile mass, which allows a contribution from a propelled portion of the crush cone, is sufficient to yield satisfactory agreement between measured and calculated results.

39520 (UCID—18165) **H.E. EMP: The "HASH".** Wouters, L.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Apr 1979. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

The electromagnetic radiation emitted in the rf domain by small HE explosions (order of one kg) was previously studied. In particular, the slower structure of the time-domain EMP (1 to 20 milliseconds was studied. The "hash" that commonly accompanies the actual chemical reaction (during the initial 10 to 100 microseconds) was also observed. This early random em structure from a variety of H.E. configurations has been observed by others. The present work shows that a particular mechanism, i.e., the piezoelectric effect with dielectric breakdown, very likely accounts for this initial phenomenon.

39521 **Thermally stable, plastic-bonded explosives.** Benziger, T.M. (to Dept. of Energy). US Patent Application 920,415. 29 Jun 1978. 10p.

By use of an appropriate thermoplastic rubber as the binder, the thermal stability and thermal stress characteristics of plastic-bonded explosives may be greatly improved. In particular, an HMX-based explosive composition using an oil-extended styrene-ethylene-butylene-styrene block copolymer as the binder exhibits high explosive energy and thermal stability and good handling safety and physical properties.

NUCLEAR

39522 (AD-A—059705) **The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report.** Banks, N.E.; Klem, G.J.; Lichtenstein, H. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Jul 1978. 64p. NTIS PC A04/MF A01.

The SAMCEP code (BRL CR 330) is used to perform sensitivity studies to determine the effects of moisture content in the air and ground and different ground compositions upon the predicted tactical nuclear environments produced by a nuclear burst. Neutron and secondary gamma fluences, energy deposition rates and Compton electron currents are given for various combinations of 0% - 6% water vapor content of the atmosphere; Nevada Test Site (NTS), typical German dry and German wet soils; and different weapon sources and burst heights.

CIVIL USES

39523 (NVO—202) **Project gnome decontamination and decommissioning plan.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Apr 1979. 34p. Dep. NTIS, PC A03/MF A01.

The document presents the operational plan for conducting the final decontamination and decommissioning work at the site of the first U.S. nuclear detonation designed specifically for peaceful purposes and the first underground event on the Plowshare Program to take place outside the Nevada Test Site. The plan includes decontamination and decommissioning procedures, radiological guidelines, and the NV concept of operations.

WEAPONRY

39524 (AD-A—058301) **Blast and thermal effects of multiple nuclear burst exposure of aircraft in a base-escape mode. Final report jan-oct 77.** Yeghiayan, R.P.; Lee, W.N.; Walsh, J.P. (Kaman Avidyne, Burlington, MA (USA)). Oct 1977. Contract DNA001-77-C-0053. 77p. NTIS PC A05/MF A01.

Analytical methods are employed to investigate the enhancement or attenuation of gust, overpressure, and thermal radiation effects due to multiple nuclear bursts in comparison with worst-case single burst exposure. The nuclear attack scenario assumes placement of the simultaneous nuclear bursts in a low-altitude planar hexagonal close-packed configuration to damage aircraft in a base-escape mode. Symmetry considerations are taken into account in investigating the possible aircraft position and flight path orientations.

EXPLOSION DETECTION

REFER ALSO TO CITATION(S) 39714

39525 (AD-A—058227) **Relationships between noise and mb bias applied to seismic station site selection and performance evaluation. Technical report.** Dietz, D.L.; Sax, R.L. (Texas Instruments, Inc., Dallas (USA)). 23 Mar 1978. Contract F08606-77-C-0004,. 105p.

An analysis of forty-six stations with known m/sub b/ bias, noise amplitude, and tectonic structure showed that a relationship exists among these three parameters. A wide range of slopes in the relationship of noise magnitude and bias were examined. A slope of one applied to several normal groupings of noise levels provided a precise means of predicting the performance of seismic stations within large geographical areas. This interpretation resulted in three distinct noise zones within interior continental areas, and very high coastal noise zones in other areas. The zones are believed to extend over large geographical areas of the earth, but are not as closely correlated with tectonic province as magnitude bias. This model and others for describing relationships between noise levels and bias were statistically tested with positive results at the 95% or 99% level of confidence. The results of the models and measurements of noise and bias were used to evaluate hypothetical 100 station networks in terms of detection and location capability and bias of network magnitude determinations.

39526 (AD-A—059529) **Relationship between near-field and teleseismic observations of seismic source parameters. Final report 1 Apr 73-30 Sep 77.** Alexander, S.S. (Pennsylvania State Univ., University Park (USA). Dept. of Geosciences). Jul 1978. 133p. NTIS PC A07/MF A01.

The following summary outlines the accomplishments under this grant. It was determined: (1) There are significant variations in body-wave and surface wave excitation for explosions of comparable magnitude detonated in similar source media and located only a few kilometers apart at NTS (Yucca Flats and Pahute Mesa). These observed differences in excitation and energy partitioning imply either a rapidly varying tectonic stress field in the source region and/or strongly varying patterns of near-source fracturing. Source-generated P-wave code of two minutes duration or more are observed at NORSAR to vary significantly in strength and character among nearby Yucca and Pahute events, possibly due to short-period surface wave to P-wave scattering; (2) that relatively few SRO-type stations can be used to compare source mechanisms for suites of events of varying size in a given source region. For example, foreshocks and aftershocks of the Utah-Idaho border and Oroville, California sequences of 1975, as recorded at the Albuquerque SRO station, have been analyzed and compared; in both cases the principal foreshock exhibited the same mechanisms as the main shock, while the aftershocks are more varied in mechanism. For both sequences we were able to match the observed Love and Rayleigh waveforms and spectra as the mechanisms changed. Average path dispersion (Hence structure is a useful by-product of the analysis.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 38892, 38893, 40050

39527 (PB—284399) **Annotated bibliography of Interagency Energy/Environment R and D Program publications.** Laska, R.; Epstein, J. (Vitro Labs., Silver Spring, MD (USA)). Oct 1977. Contract EPA-68-01-2934. 39p. NTIS PC A03/MF A01.

The annotated bibliography contains information pertaining to publications sponsored by the Environmental Protection Agency's Interagency Energy/Environment Research and Development Program. The intent of this document is to assist the researcher or the interested public in identifying and locating documents which are pertinent to their current interests.

BASIC STUDIES

REFER ALSO TO CITATION(S) 38332, 40051

39528 (BNL—25026) **Atmospheric turbulence and diffusion boundary layer transport model.** Lee, H.N. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-790101—8). Dep. NTIS, PC A02/MF A01.

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

The structures of the turbulent motion in the lower atmosphere over nonhomogeneous low hill terrain were investigated by integrating numerically high-order closure turbulence transport equations with momentum equations. The finite element numerical technique and model developed could be extended to a non-neutral case. The proposed dynamic formulation of the eddy viscosity coefficient is particularly attractive and can provide a viable alternative approach to study the atmospheric turbulent motion and diffusion over a complicated irregular terrain.

39529 (CONF-790101—6) **Dry deposition and emission of small particles at the surface of the earth.** Wesely, M.L.; Hicks, B.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

Direct eddy-correlation measurements of the net particle exchange between the atmosphere and the surface over 24 hr periods are reported for several natural surfaces. The diurnal trends of the particle flux found over some surfaces indicate that the mechanisms that control the net exchange with the surface are complicated by processes, perhaps biological and chemical, at the surface. Over rather rough vegetated surfaces, the fluxes appear to be directed upwarded at night and downward part of the day. The maximum surface resistance found is about 0.6 s cm^{-1} for particles 0.05—0.1 μm in diameter over a grassy surface, and about 1.5 s cm^{-1} for a wide range of submicron particles over pine trees. For submicron particles over pine trees and senescent maize, the net flux averages over 24 hr appears to be near zero. Over snow and cold, wet, bare soil, the particle fluxes were almost always directed upward. In summary, it appears that vegetation can remove particles from the atmosphere quite efficiently at times, resulting in a deposition velocity near 1.0 cm s^{-1} (or an effective surface resistance of about 1 s cm^{-1}), but particle removal by smooth surfaces is extremely limited. In order to account for the net changes of particulate material in the lower atmosphere due to surface removal, biological and chemical processes at the surface or very neat to it must be more fully understood.

39530 (COO—2360-6) **Effects of mesosclae weather disturbances on contamination concentrations. Fifth technical progress report.** Kreitzberg, C.W. (Drexel Univ., Philadelphia, PA (USA)). Sep 1978. Contract EY-76-S-02-2360. 57p. Dep. NTIS, PC A04/MF A01.

The objective of this research is implementation of a Prototype Regional Meteorological Forecast System (PRMFS) in the Eastern United States. This system could function in real-time to supply meteorological input to air pollution, washout, coastal oil spill transport, and weather dependent fuel use models out to 24 hours in advance. Considerable effort is being devoted to testing and verifying the system and to developing a more detailed boundary layer model, including a vegetated ground layer. The forecast model has been run at Brookhaven National Laboratory and compared with the identical case run at the National Center for Atmospheric Research. This transfer included conversion of certain machine dependent codes and packing of the data within the core of the CDC-7600 at Brookhaven. The trajectory code was used on the storm of April 1974, to demonstrate the sensitivity of cleansing computations to grid size. The prototype system was reorganized into a coherent system of codes with a common structure and coding style. The FORTRAN pre-processor has been changed from FRED to FLOTRAN, an extended version of IFTRAN that permits use of the FLOW library of data transfer routines. These improvements in software provide greater portability, flexibility, and reliability so that the model at Brookhaven National Laboratory will function efficiently and remain at the forefront of the state-of-the-art of detailed weather prediction.

39531 (DOE/TIC—10043) **Environmental/resource assessment and information.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). 1979. 10p. National Oceanic and Atmospheric Administration, Washington, DC.

This publication contains: a weekly energy assessment titled Heating Degree Days and Temperature Related Consumption of Natural Gas and Other Fuels for the U.S.; monthly printouts and descriptive maps, with one and three month outlooks, titled Heating Degree Day Summary and Outlook.

39532 (N—78-27706) **An evaluation of in situ ozone sensor performance during a cold frontal passage.** Parsons, C.L. (National Aeronautics and Space Administration, Wallops Island, VA (USA). Wallops Station). Jul 1978. 34p. NTIS PC A03/MF A01.

The capabilities of the electrochemical concentration cell ozonesonde for measuring the vertical profile of atmospheric ozone were studied during a three day experiment at Wallops Island, Virginia, and Norfolk, Virginia. Using ancillary measurements at the surface and the spectrophotometer, it was concluded that the ozonesonde measures the total ozone overburden to within 10% of the real value. By releasing the balloon-borne instruments at a rate of four per day at each of the two sites, an indication was obtained of the temporal and spatial scales of atmospheric ozone variability. No significant effects of a weak cold front passage or of the loss of insolation at night were seen. An isolated incident of anomalously high ozone concentration at the peak of the profile was attributed to sporadic instrument performance effects. The data base currently available is not adequate for determining an exact cause of the anomaly.

39533 (UCRL—82542) **Stratospheric H_2O.** Ellsaesser, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Mar 1979. Contract W-7405-ENG-48. 13p. (CONF-790607—1). Dep. NTIS, PC A02/MF A01.

From NASA stratospheric workshop; Harper's Ferry, WV, USA (4 Jun 1979).

Documentation of the extreme aridity ($\sim$ 3% relative humidity) of the lower stratosphere and the rapid decrease of mixing ratio with height just above the polar tropopause (20-fold in the 1st km) was begun by Dobson et al., (1946) in 1943. They recognized that this extreme and persistent aridity must be dynamically maintained else it would have been wiped out by turbulent diffusion. This led Brewer (1949) to hypothesize a stratospheric circulation in which all air enters through the tropical tropopause where it is freeze dried to a mass mixing ratio of 2 to 3 ppM. This dry air then spreads poleward and descends through the polar tropopauses overpowering upward transport of water vapor by diffusion which would otherwise be permitted by the much warmer temperatures of the polar tropopauses. Questions can indeed be raised as to the absolute magnitudes of stratospheric mixing ratios, the effective temperature of the tropical tropopause cold trap, the reality of winter pole freeze-dry sinks and the representativeness of the available observations suggesting an H_2O mixing ratio maximum just above the tropical tropopause and a constant mixing ratio from the tropopause to 30 to 35 km. However, no model that better fits all of the available data is available, than does the Brewer (1949) hypothesis coupled with a lower stratosphere winter pole, freeze-dry sink, at least over Antarctica. (JGB)

39534 **Meteorological aspects of energy use.** Junod, A. (Swiss Meteorological Inst., Payerne, Switzerland). pp 365-372 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

After introducing some basic concepts on climate and climatic change, the general relationships between energy use and meteorology are discussed in view, first, of the present conditions and, second, of possible future developments. As regards the latter the usefulness of scenarios is stressed, in order to avoid the deceiving application of forecasts in an area where geophysical and anthropogenic factors are mixed up. Besides special consideration is given to the meteorological assessment of the potentialities of non-conventional energy resources such as wind and solar energy.

39535 **Tropospheric aerosols.** Junge, C. (Max-Planck-Institut fuer Chemie, Mainz, Germany). pp 2-5 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

Tentative figures for the background aerosol composition with respect to the four major sources are given: (1) sulfate, fairly uniformly distributed: $\sim$ 0.4 to 1.0 $\mu g/m^3$; (2) mineral dust, fluctuating widely: $\sim$ 0.1 to 1 $\mu g/m^3$; (3) sea salt, fairly uniform: $\sim$ 0.1 to 0.5 $\mu g/m^3$; and (4) organic matter, apparently fairly uniform: $\sim$ 0.4 to 0.8 $\mu g/m^3$. On the basis of these figures sulfate and organic matter may in general turn out to be the dominant constituents. Since about 80% of the volume of the entire troposphere is filled with this aerosol, improved knowledge of its composition, size distribution, contributing sources and physical properties is certainly needed not only as a basis for understanding the global cycles of many trace substances but also for quantitative consideration of the atmospheric radiative budget.

39536 **Dominance of tropospheric sulfate in modifying solar radiation.** Charlson, R.J.; Vanderpol, A.H.; Waggoner, A.P.; Covert, D.S.; Baker, M.B. (Univ. of Washington, Seattle). pp 32-36 of

Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

An integrated analysis of size distribution and chemical data from several sources indicates that sulfate in particulate matter dominates the accumulation mode, optically important aerosol a large fraction of the time in the eastern US and northern Europe. Levels of turbidity and light scattering are controlled by the presence of this sulfate aerosol. The ratio R and the increase in aerosol scattering at high RH are determined by the molecular form of the aerosol through refractive index and hygroscopic growth. A discussion of the role of particulate sulfur compounds in the radiative climate of the earth was presented. The sources of these aerosols are not well quantified. If anthropogenic contributions to the atmospheric sulfur budget are large compared to natural sources, trends may become apparent in data such as are presented here. This overall analysis points out that it is possible and worthwhile to investigate the role of an individual class of substances as it affects aerosol scattering properties and solar radiation.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38088, 38091, 38094, 38199, 38599, 38892, 38893, 39202, 39208, 39581, 39612, 39615, 39693

39537 (AD-A—057461) **Aquatic disposal field investigations, Ashtabula River disposal site, Ohio. Appendix C. Investigation of water-quality and sediment parameters. Final report December 1974—January 1977.** Wyeth, R.K.; Sweeney, R.A. (State Univ. Coll., Buffalo, NY (USA). Great Lakes Lab.). Jul 1978. Contract DACW39-75-C-0110. 353p. NTIS PC A16/MF A01.

An investigation to evaluate impacts of the release of dredged material on chemical aspects of the aquatic and benthic environments was conducted in Lake Erie off Ashtabula, Ohio, from June 1975 through September 1976. Samples and measurements were taken prior to, during, and after the release of materials from a hopper dredge during August 1975 and May 1976. The impact on the water column was short-lived with a return to ambient predisposal conditions for most parameters within 90 minutes after release of dredged material. Impacts on interstitial water generally dissipated in less than 90 days after disposal. The benthic environment was the most affected in terms of chemical changes. A return of predisposal conditions did occur within a year primarily due to erosion. There was no evidence of heavy metals accumulations by either benthos or fish as a consequence of disposal of dredged material. A Standard Elutriate Test preparation time dependency study also was done. This investigation resulted in some suggested changes for improving reliability. (Author)

39538 (AD-A—059809) **The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78.** Tully, F.P.; Ravishankara, A.R. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 31 Jul 1978. Contract F49620-77-C-0111. 28p. NTIS PC A03/MF A01.

Utilizing the technique of flash photolysis-resonance fluorescence the rate constants for the reactions of hydroxyl radicals (OH) with methane and carbon monoxide have been measured up to 825 K. Curvatures have been observed in the Arrhenius plots for both reactions. The measured rate constants have been compared with the previous measurements reported in the literature. Oxidation of BF3 and BCl3 by both O2 and O3 have been studied. The rate of oxidation of these haloboranes by O2 is negligibly small. O3 oxidizes BCl3 (but not BF3) at a measurable rate.

39539 (ANL/RER—78-2) **Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants.** Sisterson, D.L.; Shannon, J.D. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 76p. Dep. NTIS, PC A05/MF A01.

Meteorological and air-quality structure along a vertical cross-section oriented in a WSW-ENE line between Salem, Ill., and New York City, N.Y., during the period 1-10 August 1977 is examined in detail. Data used are derived from regular and special soundings from each of five rawinsonde stations centered along the northern edge of the Ohio River Valley, vertical air-quality profiles obtained by instrumented aircraft, and an acoustic sounder record. Despite some limitations in the temporal and spatial resolution of these data, there are indications of regional transport of pollutants along isentropic surfaces with little dilution when layers aloft are decoupled from the surface by ground-based inversions. Part I of this report contains cross-section analyses of the meteorological fields, while Part II contains profiles of temperature, humidity, and certain air-quality parameters, plus cross-section analyses of the aerosol-related, optical property b/sub scat/, the particular quantity found to show the greatest evidence of isentropic transport.

39540 (BNL—25002) **Comparison of particulate and gaseous material within and above the mixed layer.** Michael, P.; Brown, R.M.; Garber, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790101—12). Dep. NTIS, PC A02/MF A01.

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

A measurement program to establish details on the vertical distribution of material in the atmosphere is described. Real time simultaneous vertical airborne concentration measurements of total particulates, sulfur dioxide, and oxides of nitrogen coupled with time integrated measurements of sulfate were correlated with temperature profiles and air mass circulation to show the degree and type of variability found within and above the mixed layer. Results document the variability that exists in the sulfur dioxide and sulfate concentrations within and above the mixed layer. Results document the variability that exists in the sulfur dioxide and sulfate concentrations within and above the mixed layer. The data show that significant amounts of material can exist and are thus transportable above the mixed layer. While this is generally expected to occur due to material remaining aloft when a ground-based inversion is formed overnight, the observations reported here indicate that the convergence accompanying a low pressure system may also be responsible for pumping material aloft. It is felt that this mechanism may well contribute significantly to long-range transport and to the dilution of material, and should be considered in regional-scale transport models. (JGB)

39541 (COO—1199-54) **Comparison of precipitation chemistry data at a central Illinois site in 1954 and in 1977.** Stensland, G.J. (Illinois State Water Survey, Urbana (USA)). 1978. Contract EY-76-S-02-1199. 27p. (CONF-780636—13). Dep. NTIS, PC A03/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

In 1954 detailed precipitation chemistry measurements on samples from a manually operated wet-only collector provided data for the concentrations of the major ions for precipitation events. A comparison with data for the same location for 1977, collected with an automatic wet-only collector, showed that the median sulfate and nitrate concentrations were somewhat larger than in 1954 while the median calcium plus magnesium concentration was much lower. The precipitation event median pH was also much lower in 1977. Possible explanations for the present lower calcium plus magnesium concentrations and the correspondingly lower pH values are given.

39542 (GKSS—78/E/42) **Mobile lidar system for the measurement of gaseous pollutants in atmospheric air.** Weitkamp, C.; Harms, J.; Lahmann, W.; Michaelis, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1978. 15p. (CONF-7810164—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 4. European electro-optics conference; Utrecht, Netherlands (10 Oct 1978).

A mobile lidar system for the remote space-resolved measurement of gaseous pollutants by the differential absorption and scattering technique is described.

39543 (IVL-B—449) **Role of ammonia in the chemistry of atmospheric aerosols.** Brosset, C. (Swedish Water and Air Pollution Research Lab., Goeteborg). Jun 1978. 34p. Dep. NTIS (US Sales Only), PC A03/MF A01.

In the years 1974—1976, investigations were carried out in different places in Sweden to determine the concentration of H^+ and NH^+_4 in the water-soluble part of airborne fine particles. It was found that the concentration quotient H^+/NH^+_4 varies in a rather systematic manner. This variation indicates that particles present in the air over an agricultural area take up ammonia. On the other hand, they seem to release this component when present over a forest district with acid lakes. Under equilibrium conditions, the quotient H^+/NH^+_4 is dependent more or less directly on the atmospheric partial pressure of ammonia. However, in particle samples this quotient will not be solely dependent on the equilibrium position but also on the time factor. Other parameters likely to influence the concentration quotient H^+/NH^+_4 are the flow of ammonia from or to the ground, and transport conditions.

39544 (LBL—7284) **Application of x-ray emission spectra to the identification of particulate sulfur compounds in ambient air.** Ramponi, A.J.; Jaklevic, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

X-ray emission spectra was found to be an effective method for the observation of the chemical form of particulate sulfur in ambient air. Realizing the unique spectral characteristics of sulfate,

an instrument for analyzing pollution filters for sulfate concentrations can be considered. A knowledge of the peak positions and relative peak intensities dispenses with the need to perform time consuming scans. A sealed, helium fille Bragg spectrometer that allows for precise external rotation of the diffracting crystal would permit consecutive measurements of the peak counting rates. A detailed investigation of the $K\beta/K\beta'$ ratio (observed to be about 3 to 1) through a least squares comparison with a standard sulfate sample would yielded information concerning the sulfate concentration. Any counts remaining in the main peak after removing the sulfate contribution can be attributed to other forms of sulfur, most notably sulfides.

39545 (LBL—7999) **Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis.** Jaklevic, J.M.; Adachi, R.S.; Goulding, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1978. Contract W-7405-ENG-48. 5p. (CONF-790415—2). Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

A combined air particulate sampler and elemental sulfur analyzer was developed for continuous monitoring of fine particulate sulfur. It consists of a dichotomous sampler, continuous tape membrane filter system, and single-channel wavelength dispersive x-ray fluorescence spectrometer. The unit operates automatically under microprocessor control and is designed to be transportable to remote sampling sites. Calibration data are retained within the microprocessor program and the concentrations are available shortly after the completion of the sampling period. Operating results are summarized briefly.

39546 (N—78-27614) **An experimental/analytical program to assess the utility of lidar for pollution monitoring. Final report, 1 September 1976—31 October 1977.** Mills, F.S.; Allen, R.J.; Butler, C.F.; Kindle, E.C. (Old Dominion Univ., Norfolk, VA (USA). Dept. of Physics and Geophysical Sciences). Jun 1978. 46p. NTIS PC A03/MF A01.

The development and demonstration of lidar techniques for the remote measurement of atmospheric constituents and transport processes in the lower troposphere was carried out. Particular emphasis was given to techniques for monitoring SO^2 and particulates, the principal pollutants in power plant and industrial plumes. Data from a plume dispersion study conducted in Maryland during September and October 1976 were reduced, and a data base was assembled which is available to the scientific community for plume model verification. A UV Differential Absorption Lidar (DIAL) was built, and preliminary testing was done.

39547 (N—78-27687) **Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977—15 April 1978.** Goldman, A. (Denver Univ., CO (USA). Dept. of Physics). 15 Apr 1978. 80p. NTIS PC A05/MF A01.

Two balloon flights reaching float altitudes of approximately 30 and 40 km respectively, were used to obtain scans of the ultraviolet and visible solar spectra. Both flights covered the UV (2800-3500A) at approximately 0.3A resolution and the visible at approximately 0.6A. Numerous scans were obtained during ascent and from float for both flights. All spectral scans obtained at float, from high sun to low sun, were calibrated in wavelength by using several standard solar spectra for line position references. Comparisons of low sun scans and high sun scans show significant atmospheric continuum extinction and have the potential of being used to identify atmospheric lines superimposed on the attenuated solar spectrum. The resolution was mathematically degraded to approximately 5A to better see the broad band atmospheric extinction. This low resolution is also appropriate for the available low resolution absorption coefficients of NO^2 and O^3, allowing the identification of NO^2 and O^3 features on the sunset spectra.

39548 (N—78-28761) **Tipping-vessel recording raingauge.** Liptrot, N.A. (Central Electricity Generating Board, London (UK)). Mar 1978. 9p. NTIS PC A02/MF A01.

As part of investigations into the long range drift of sulphur dioxide, rainfall was measured at ten sites. The rainfall was collected weekly when the sulphur dioxide instruments were serviced. The volume of rainwater was measured and a sample of up to 300 ml was brought to the laboratory for analysis of constituents. Commercially obtained clockwork recording rain gages, installed at three of the sites to measure the time and intensity of rainfall, proved unreliable due to faults with the chart drive units and many results were lost.

39549 (N—78-30725) **Remote sensing of atmospheric pollution from space.** Harries, J.E. (National Physical Lab., Teddington (UK)). Apr 1978. 47p. NTIS PC A03/MF A01.

A brief review is presented of techniques and instruments for remotely sensing pollution in the lowest layers of the earth's atmosphere from an orbiting spacecraft. The associated difficulties and problems including the weakness of pollutant signals; the high intensity of background radiation; scattering and attenuation due to clouds, aerosols and particulate matter; and atmospheric temperature structure anomalies are discussed. Four basic techniques which should be investigated further are discussed. These are laser absorption spectrometer; microwave absorption spectrometer; gas correlation radiometer; and correlation spectrometer. It is concluded that a combination of several sensors may eventually be used in an operational mode and that further studies of these selected areas should be carried out leading to test flights possibly utilizing platforms such as Spacelab and the space shuttle.

39550 **Model for coal fly ash filtration.** Dennis, R.; Klemm, H.A. (Geophysics Corp. of America, Bedford, MA). *J. Air Pollut. Control Assoc.;* **29**: No. 3, 230-234(Mar 1979).

A new mathematical model for predicting the performance of woven glass filters with coal fly ash is described. The data base for this development includes an extensive bench and pilot scale study, field data from prior studies of fly ash filtration with glass fabrics, past studies of fabric filter cleaning mechanisms and a literature survey. Trial model applications with utility boilers operating at Sunbury, PA and Nucla, CO indicate excellent agreement between theory and practice for penetration and resistance characteristics. The introduction and experimental confirmation of two physical relationships were instrumental in model design. The first describes how dust dislodges from a fabric and its subsequent impact upon resistance and penetration in a multichambered system. The second concept relates to the large fraction of ash that passes through temporarily or permanently unblocked pores such that particle penetrations are essentially size independent. Additionally, the quantitation of the cleaning action and energy with dust removal method is included in the model. The calculation of dust specific resistance coefficient, based on size distribution parameters provides improved estimates of K_2 in lieu of its preferred direct measurement.

39551 (ORO—5592-2) **Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977—November 30, 1978.** Matteson, M.J. (Georgia Inst. of Tech., Atlanta (USA)). 1978. Contract EE-77-S-05-5592. 14p. Dep. NTIS, PC A02/MF A01.

The first phase of this research involved the measurement of the uptake of sulfur dioxide and other gases by large, single water droplets growing by condensation or evaporating. Gases were mixed in a humid nitrogen stream and allowed to flow past a suspended cold (ca 7°C) droplet about 2.5 mm in diameter. The temperature of the droplet was monitored and the absorbed gas concentration measured after various exposure times. Gases investigated were SO_2 (1000 to 3000 ppM), NO_2 (100 to 300 ppM) and O_2 (21 to 80%). It was found in all three cases that gases absorbed during droplet growth are transferred at greater rates and in higher concentrations than the no-growth condition. If the droplets are allowed to evaporate, much less gas is absorbed; and if the droplet already contains a gas absorbed during a condensation step, some of this may be desorbed during a subsequent evaporation step. Similar tests were conducted with droplets which contained known amounts of vanadium pentoxide, manganese chloride, and carbon black. These additives all accelerated the absorption rate during condensation, however, only V_2O_5 solution retained the SO_2 and prevented its desorption during evaporation.

39552 (PB—283696) **Ambient monitoring guidelines for prevention of significant deterioration (PSD).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). May 1978. 71p. NTIS PC A04/MF A01.

Ambient air monitoring guidelines are described for sources that may be required to monitor the air quality under the Prevention of Significant Deterioration (PSD) regulations. Some step-by-step discussion is presented for a source to determine if monitoring will be necessary. Situations where existing air quality and meteorological data, modeling, and use of assumed background concentrations for certain areas may be used in lieu of monitoring, are shown. If a source must undertake a monitoring program, general guidance is given for pollutants to be monitored, number and location of monitoring sites, equipment, frequency and duration of sampling, and data reporting. More detailed guidance is discussed for air quality monitoring probe siting criteria for various pollutants, meteorological monitoring, and quality assurance procedures.

39553 (PB—284338) **Systems for rapid ranking of environmental pollutants: selection of subjects for scientific and technical assessment reports. Final report.** Brown, S.L.; Holt, B.R.; McCaleb, K.E. (Stanford Research Inst., Menlo Park, CA (USA)). Jun 1978. Contract EPA-68-01-2940. 281p.

This document reports the results of the development and testing of a system for rapidly ranking environmental pollutants. One potential use for the system is in choosing the most important candidates for Scientific and Technical Assessment Reports (STAR). Of several possible approaches to ranking environmental agents, a

system depending on expert opinion but assisted by an objective subsystem, was selected for development. The system defines procedures for collecting, processing, and evaluating data on production and use; environmental transport, transformation, and rate; and human health and welfare and ecological effects. A test of the objective subsystem confirmed the utility of the system. Of ten candidate agents, the three highest ranked were cyanides, carbon disulfide, and beryllium.

39554 (PB—284400) **Results of research related to stratospheric ozone protection. Report to congress.** Ruff, R.E.; Russell, P.B.; Kaplan, S.D.; Holt, B.R.; Ryan, J.W. (SRI International, Menlo Park, CA (USA)). Jan 1978. Contract EPA-68-01-3939. 50p. NTIS PC A03/MF A01.

Research on ozone protection has been coordinated under the Biological and Climatic Effects Research (BACER) Program. This is a multiagency, multidisciplinary effort initially funded by The Environmental Protection Agency. Its purpose is to reduce uncertainties regarding ozone depletion to improve regulatory decision-making. Health, biological, ecological, climatic and social/economic effects are studied. Activities include surveys of skin cancer among populations at different latitudes, measurements of solar UV-B (290-320nm) at the sites, tests of over 100 plant species under simulated and natural UV-B levels, experiments with aquatic ecosystems, and social/economic workshops. Results to date are as follows: surveys generally support belief that skin cancer incidence is related to UV-B exposure; mortality from skin cancer is increasing among the young, probably due to changes in life style--more time outdoors; all plants tested are sensitive to UV-B at some exposure level; some plants are stunted, others suffer bleached or discolored leaves; UV-B damages larvae of shrimp, crab, mackerel and anchovy; photorepair mechanism is suggested as a potential mitigator of UV-B effects in plants; field type, medium resolution spectroradiometer and calibration standards were developed; and a conceptual model, including parameter uncertainties, is developed for integrated assessment of costs/benefits of control vs. non-control. Reliability of assessments increase as parameter uncertainties decrease--do not have to revise model for new data.

39555 (PB—284823) **Biological solar energy conversion approaches to overcome yield stability and product limitations. Progress report no. 6, 1 October 1977-31 March 1978.** Kok, B.; Fowler, C.F.; Radmer, R.J.; Velthuys, B.V. (Martin Marietta Labs., Baltimore, MD (USA)). 1978. 37p.

A series of experiments were performed in which the authors monitored chlorophyll fluorescence in parallel with the mass spectrometer gas exchange measurements. It was observed that the fluorescence yield is not significantly altered when O2, rather than CO2, was the terminal electron acceptor, and it was concluded that the state of the photosynthetic apparatus is not strongly affected by a changeover from CO2 fixation to O2 reduction, or vice-versa. The study of photosynthetic activities in chloroplasts and particles of corn leaves was continued. Improved rates of photosystem I sheath particles were obtained. The feasibility of measuring the relative contents of system I and system II photocenters in spinach and maize chloroplasts has been examined. Measurements at 430nm with detergent-treated material indicate that the bundle sheath chloroplasts have 70 percent more system I than do spinach chloroplasts. To measure system II content, two methods have been used. In one, the flash-induced trans-membrane electrical field is used as a probe. Another method measures 'C-550' to indicate Q, the primary acceptor of system II. The second method appears more reliable than the first and indicates that bundle sheath chloroplasts contain 40% less system II than spinach chloroplasts.

39556 (PB—284826) **Chalk Point Cooling Tower Project. Volume I, phase V. Analysis and archiving program, FY77. Final report, 1 July 1976—31 August 1977.** Margetts, M.J. (Environmental Systems Corp., Knoxville, TN (USA)). May 1978. 336p. NTIS PC A15/MF A01.

Results of field measurements and data analysis as part of the Chalk Point Cooling Tower Project (CPCTP) for the Fiscal Year 1977, are presented in two volumes. Volume 1 contains results from the following program areas: (1) Chalk Point Meteorological Tower operation including summaries of meteorological data for the site; (2) Scheme for archiving the Chalk Point data sets; (3) Analysis of cooling tower emission data, ambient salt concentration data, and plume photography; and (4) Modeling including a model survey, preliminary model sensitivity work and an examination of Chalk Point data for consistency and sufficiency for modeling. (Portions of this document are not fully legible)

39557 (PB—284827) **Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976—31 August 1977.** Margetts, M.J. (Environmental Systems Corp., Knoxville, TN (USA)). Dec 1977. 112p. NTIS PC A06/MF A01.

A description and results of ESC's participation in the Chalk Point Cooling Tower Project Dye Tracer Experiment is presented together with reduced data. Measurements were conducted during two data acquisition periods on the afternoon and evening of June 16, 1977, at PEPCO's Chalk Point Generating Station. Data were acquired in four major areas: (1) Unit Number 3 Cooling Tower Emission Characterization; (2) Meteorological Tower Data; (3) Ground-Level Measurements; (4) Plume Photography. In addition, Unit Number 3 power generation data for the test period are included as summarized from PEPCO's log and are given in Section E of each Appendix. The measurements were performed successfully without major problems. Results of the measurements are compared with the results of the CPCTP Summer Seasonal Test conducted in June 1976.

39558 (PB—284866) **Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975—March 1977.** Rao, S.T.; Chen, M.; Keenan, M.; Sistla, G.; Peddada, R. (New York State Dept. of Environmental Conservation, Albany (USA)). Jun 1978. 66p. NTIS PC A04/MF A01.

The major emphasis of this investigation centered on the collection of particulate and gaseous pollutant data, and detailed micrometeorological data in a non-urban setting adjacent to the heavily travelled Long Island Expressway. The purposes for collecting the data were to: (1) document the distribution of sulfate, lead, total particulates and carbon monoxide at an array of sampling points adjacent to the highway; (2) study the micrometeorology associated with the highway, with special attention to those parameters important in the determination of atmospheric dispersion; (3) reevaluate highway air pollutant emission factors from data gathered in tracer gas experiments; and (4) examine the applicability of existing highway air pollutant dispersion models. The location of the sites and the experimental setup for collecting pollutant data are described, and details of the data acquisition procedures are presented.

39559 (PB—284905) **Analysis of meteorological conditions during the 1977 Anclote Keys Plume Study. Final report, February—November 1977.** Hull, L.; Dannevik, W.; Woodford, R. (Environmental Quality Research, Inc., Clayton, MO (USA)). Jul 1978. Contract EPA-68-02-2500. 70p. NTIS PC A04/MF A01.

Meteorological conditions are described and analyzed for nine experimental observation periods of the Anclote Keys Plume Study, which was conducted near Tampa, Florida during February 1977. The primary objective of the Plume Study was to investigate both the short and long range transport of power plant plumes and the formation rate of sulfate in a marine environment. The forecasting center, radiosonde, pilot balloon, and tethersonde systems are also described, and the data acquisition schedules are included. Raw pilot balloon and tethersonde observations and the derived wind fields are not included, but are available from the authors.

39560 (PB—284938) **Analytical system for measuring malodorous compounds from kraft mills. Final report.** Mulik, J.D.; Stevens, R.K.; Baumgardner, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jul 1978. 27p. NTIS PC A03/MF A01.

Automated chromatographs equipped with flame photometric detectors were developed for the qualitative and quantitative analysis of low- and high-molecular-weight sulfur compounds in kraft mill effluents. One chromatograph equipped with a Teflon column packed with Teflon and coated with polyphenyl ether measured the following low-molecular-weight sulfur compounds: hydrogen sulfide (H2S), sulfur dioxide (SO2), methyl mercaptan (CH3SH). A second chromatograph equipped with a Teflon column packed with Teflon and coated with Triton X-305 measured the higher-molecular-weight sulfur compounds: butyl mercaptan (C4H9SH), dimethyl disulfide ((CH3)2S2), and dibutyl sulfide ((C4H9)2S). Kraft mill effluents containing sulfur species ranging in concentrations from 5 ppb to percent levels were analyzed using a 6-stage dynamic dilution system. Sulfur emission data were collected from two kraft mills, one employing strong black liquor oxidation and the other weak black liquor oxidation. Part of the study was dedicated to determining the relationship between the total gaseous sulfur and the individual sulfur compounds observed chromatographically. In most cases, more than 90 percent of the sulfur emitted from the kraft mills studied was accounted for by chromatographically identified compounds.

39561 (PB—284973) **The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976—April 1978.** Serne, J.C.; Wilson, K. (Pacific Environmental Services, Inc., Santa Monica, CA (USA)). May 1978. Contract EPA-68-02-1405. 344p. NTIS PC A15/MF A01.

The report gives results of an investigation of the use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Data from nine integrated steel plants and two consultants

with extensive steel industry experience were used to: develop correlations between lubricant usage rates and steel production capacity, and the types of products made; and prepare total oil, grease, and hydraulic fluid material balances for specific, as well as typical, integrated steel plants. Generalizations were made regarding the fate (as air, water, and solid waste pollution) of these oils, greases, and hydraulic fluids. Air pollution emissions, total oil-and-grease water pollution discharges, and the quantity of oil and grease being disposed of in landfills were estimated by steelmaking area and for a typical integrated steel plant. Introductory and background information pertaining to the steel industry, lubrication practices, steel plant lubricants, and waste oil collection and reclamation methods are also presented. Study results indicate that, for a typical integrated steel plant with a raw steel production capacity of 4 million ton/yr, 1.2 million lb/mo of oils, greases, and hydraulic fluids are used throughout the plant. Of all lubricants used, an estimated 10% enters the environment as air pollution, 9% as water pollution, and 44% as solid waste.

39562 (PB—284974) **A program for the environmental assessment of conventional combustion processes. Final task report, March 1977—May 1978.** Kenkeremath, D.C.; Miller, C.G.; Truett, J.B. (Mitre Corp., McLean, VA (USA). METREK Div.). Jul 1978. Contracts EPA-68-01-3539;EPA-68-01-3188. 106p. NTIS PC A06/MF A01.

The report describes the development of a program plan for EPA's Conventional Combustion Environmental Assessment (CCEA) Program and presents the status of the Program 1 year after the planning effort was begun. The CCEA Program was established recently to coordinate and integrate EPA's several research and development efforts for assessing the environmental effects of pollutants from conventional combustion of fossil fuels. Much of EPA's environmental assessment (EA) activities have, in the past, been performed in connection with research, development, and demonstration projects directed principally toward controlling specific pollutants from combustion. Overall program goals and objectives are defined, and existing research and development project involving EA of combustion pollutants are identified. A procedure for analyzing the content of such projects is described and its use demonstrated for a selected subset of current projects to identify duplication of effort or gaps in coverage of areas required for attainment of defined objectives. A set of recommended actions and milestones, based on the analysis of current projects and defined Program goals, is presented.

39563 (PB—285059) **Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976—February 1977.** Hitchcock, D.R.; Spiller, L.L.; Wilson, W.E. (Hitchcock Associates, Farmington, CT (USA)). Jul 1978. 74p. NTIS PC A04/MF A01.

Atmospheric H2S, SO2, and particulate SO4(-2), Na(+), C1(-), NH4(-), and NO3(-) were measured in two experiments on the North Carolina coast to determine the levels of biogenic sulfur species at marsh and estuarine locations where dissimilatory bacterial sulfate reduction produces H2S in local anoxic muds. The first (summertime) experiment demonstrated the occurrence of variable and high H2S levels--4-h means up to 80 microgram/cu m (57 ppb)--associated with low-tide mud exposure in a Spartine alterniflora marsh. Little or no SO2 was observed here, and little or no SO2 or H2S were observed at a background site 2.4 km distant. Biogenic sulfate in marine air masses ranged from 2 to 13 microgram/cu m, and was strongly associated with the loss of chloride from marine aerosols. Both H2S and SO2 were observed in the second (autumn) experiment at concentrations up to 7 microgram/cu m (5 ppb) (H2S) and 25 microgram/cu m (17 ppb) (SO2) at an estuarine site where anoxic muds are not exposed to low tide, under conditions which implied a biogenic origin, and the rapid conversion of biogenic H2S to SO2. Particulate excess (non-sea salt) sulfate and chloride loss from marine aerosols were observed at this site in continental air masses (marine air masses did not occur).

39564 (PB—285227) **An assessment of mercury emissions from fossil fueled power plants. Final report.** Goldgraben, G.R.; Krickenberger, K.; Clifford, P.; Zimmerman, N.; Martin, D. (Mitre Corp., McLean, VA (USA). METREK Div.). Jul 1978. Contract EPA-68-01-3539. 106p. NTIS PC A06/MF A01.

The study has found no evidence of a health or environmental problem as a result of emissions of mercury from power plants. This conclusion has led to the recommendation that a specific control program to address mercury emissions from power plants is not necessary at this time. It is estimated that power plants contributed less than 8 percent of the more than 2000 tons of mercury lost to the environment by all man-made sources in 1974. Studies and scenarios indicate little or no effect of mercury from power plant emissions on ambient air or water concentrations. Localized increases could occur with soil concentrations. Direct relationship of the power plant emissions to ambient concentrations could not be ascertained. Health effects, standards and regulations, transport, and transformations of mercury are discussed.

39565 (PB—285429) **Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report.** Salvesen, K.G.; Herther, M.; Wolfe, K.J.; Chu, E. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Aug 1978. Contract EPA-68-02-2160. 286p. NTIS PC A13/MF A01.

This is part of 10 special reports on the environmental assessment of stationary source NOx combustion modification technologies program. The program has two main objectives: (1) to identify the multimedia environmental impact of stationary combustion sources and NOx combustion modification controls; and (2) to identify the most cost-effective, environmentally sound NOx combustion modification controls for attaining and maintaining current and projected NO2 air quality standards to the year 2000. The emissions characterization effort documented in Volume I of this report provides supporting data to subsequent efforts. Volume II contains the appendices to this report. They are presented as follows: Regional fuel consumption tables for 1974; National fuel consumption tables for 1985 and 2000; National criteria pollutant emissions for 1974; National emissions inventory for 1974; Regional stationary source combustion controls; National source pollution potential assessment for 1974; Pollution potential summaries for the energy projection scenarios in 1985 and 2000, and Pollution potential trends to the year 2000 for the energy projection scenarios. These appendices support the report documentation given in Volume I.

39566 (PB—285430) **Human population exposures to mirex and kepone. Criteria document.** Suta, B.E. (Stanford Research Inst., Menlo Park, CA (USA). Center for Resource and Environmental Systems Studies). May 1978. Contract EPA-68-01-4314. 150p. NTIS PC A07/MF A01.

Human exposures to mirex and kepone are assessed in this study. Three major paths of exposure are examined: ingestion through the food chain, inhalation of atmospheric mirex and kepone, and exposure through drinking water. Exposure through the food chain appears to be the most pressing current problem. Various species of commercially caught fish in certain areas of the country have been found to contain slight amounts of the compounds. It is difficult to obtain estimates of the human exposure from sport fish, but evidence seems to suggest that sportsmen and their families may be exposed through fish. Also, game captured in the southeastern U.S. has been found to contain the compounds. Kepone has been found in mothers' milk in some areas of the country. Atmospheric exposures are not considered terribly great now, since the compounds are no longer produced and the major atmospheric exposures are believed to be occupational exposure at the producing factory and exposure to workers' families from clothing, etc. Human exposure to mirex and kepone from drinking water supplies does not appear to be a problem, since both compounds are very insoluble in water. Exposure through tobacco was also considered.

39567 (PB—285662) **Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976—August 1977.** Ochsner, J.C.; Blackwood, T.R. (Monsanto Research Corp., Dayton, OH (USA)). Jun 1978. Contract EPA-68-02-1874. 137p. NTIS PC A07/MF A01.

Air and water pollutants are generated during the conversion of naturally occurring minerals into suitable forms for use in chemical and fertilizer production. These minerals are barite, borates, fluorspar, lithium minerals, mineral pigments, phosphate rock, potash, salt, sodium sulfate, sulfur, and trona ore. The representative plant size for each mineral, except borates, was determined by dividing the total annual production by the number of plants. (In the case of borates, one plant which accounts for over 75% of annual production was considered representative.) The hazard ratio for respirable particulates emitted from the representative source ranges from 0.00005 for sulfur to 0.9 for potash. Hazard ratios for water pollutants were developed only for the phosphate rock industry as it was the only industry for which complete information was available concerning river flow rate and concentration. For a representative source, the hazard ratios of elemental phosphorous, fluoride, and total suspended solids (TSS) are 0.061, 0.051, and 0.0025, respectively. The four significant wastewater problem areas in the mining and beneficiation of minerals in the chemical and fertilizer industry are mine water drainage, wastewater from the fluorspar industry, phosphate rock slimes, and sulfur bleedwater brines. The Florida phosphate rock slimes problem may well be the most important of all fertilizer production problems. Suspended solids are the principal pollutant in chemical and fertilizer wastewater discharges. While a variety of treatment technologies are available for removing suspended solids, only a small number are widely used.

39568 (PB—285980) **The development of a regional air pollution model and its application to the Northern Great Plains. Final report.** Liu, M.; Durran, D.R. (Systems Applications, Inc., San Rafael, CA

(USA)). Jul 1977. Contract EPA-68-01-3591. 297p. NTIS PC A13/MF A01.

This report describes a regional scale air quality diffusion model and its application to existing and proposed energy resource development facilities in the Northern Great Plains region. The objective of the study was to examine the air quality impacts roughly 100 to 1000 kilometers from the emissions sources. The model which was developed consists of two interconnected submodels - a mixing layer model and a surface layer model. The mixing layer model handles the transport and diffusion of pollutants well above the surface. The surface layer model was designed to calculate pollutant fluxes to the ground. Pollutant removal processes incorporated in the model include dry deposition, chemical transformation, rainout and washout. Concentrations of sulfur dioxide and sulfates were estimated for two development levels--existing and 1985 for three meteorlogical scenarios--a strong wind winter case, a stagnation spring case, and a moderate wind case.

39569 (PB—286229) **Area source emission inventory for York County, South Carolina. Final report.** Reed, G.T. (Engineering-Science, Inc., McLean, VA (USA)). Apr 1978. Contract EPA-68-92-1380. 97p. NTIS PC A05/MF A01.

An area source emission inventory for York County, South Carolina was developed. All five criteria pollutants were inventoried: particulate, sulfur dioxide, hydrocarbons, carbon monoxide, and oxides of nitrogen. Estimates were made for the baseline year, 1976, and projected to two future years: 1980 and 1985. In developing the inventory, fuel usage, solvent usage, and petroleum marketing were surveyed. Procedures outlined in EPA's Guidelines for Air Quality Maintenance Planning and Analysis were used. In addition, Mobile 1, the new EPA computer program for calculating the motor vehicle emission factors for carbon dioxide, hydrocarbons, and oxides of nitrogen, was used.

39570 (PB—286322) **Georgetown, South Carolina air quality maintenance planning and analysis. Final report.** (Engineering-Science, Inc., McLean, VA (USA)). Feb 1977. Contract EPA-68-02-1380. 228p. NTIS PC A07/MF A01.

An area source emission inventory was developed for Georgetown County, South Carolina. Baseline year emissions estimates were allocated to grids. The Air Quality Display Model (AQDM) was used to determine the source-receptor relationship for the baseline year. Using this baseline relationship and a projected emission inventory, the AQDM was used to analyze air quality attainment and maintenance in 1980 and 1985. Although all criteria pollutants were inventoried, only particulate emissions were modeled. Primary National Ambient Air Quality Standards for particulate were violated during the baseline year. The analysis indicated that the standards will continue to be violated unless more stringent controls are adopted. Further study of weather conditions and fugitive emissions from industrial point sources was recommended. Additional modeling was attempted to incorporate industrial process fugitive particulate emissions in the analysis. (Portions of this document are not fully legible)

39571 (PB—286485) **Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78.** Sherman, P.L.; Kemmer, A.M.; Metcalfe, L.; Toy, H.D. (Monsanto Research Corp., Dayton, OH (USA)). Jun 1978. Contract EPA-68-01-1980. 271p. NTIS PC A12/MF A01.

Sampling, workup and analysis methods were developed for six B-chloroethers in air, water, soil and sediment samples to evaluate possible environmental contamination by this class of compounds. The six ethers were chloroethyl ethyl ether, chloroethyl/vinyl ether, bis-(2-chloroethyl) ether, bis(2-chloroisopropyl) ether, bis(2-chloroethoxy) methane and bis(2-chloroethoxy) ethane. Four types of samples were collected near eight industrial sites which were potential emitters of B-chloroethers. The sites included four plants where propylene oxide is produced via the chlorohydrin route. One plant produced propylene chlorohydrin; one plant produced both ethylene chlorohydrin and propylene chlorohydrin, and had produced various B-chloroethers previously; one plant produced intermediates and surfactants for the textile industry; and one plant produced polysulfide rubbers. Air samples were collected by drawing air through Pyrex tubes packed with Tenax-GC using personnel sampling pumps. Water samples were collected either as grab samples or integrated 24-hour samples with a peristaltic pump. Soil and sediment samples were transported in glass canning jars. Air sampling tubes were desorbed with methanol with a procedure developed at MRC. Water samples were solvent extracted with methylene chloride. Soil and sediment samples were Soxhlet extracted with methylene chloride. The methylene chloride extracts from the water, soil and sediment samples were each concentrated with a Kuderna-Danish evaporator to a volume of 2-3 ml.

39572 (PNL—2829) **MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977—June 1978.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1979. Contract EY-76-C-06-1830. 136p. Dep. NTIS, PC A07/MF A01.

The MAP3S Precipitation Chemistry Network consists of eight sites located in the northeastern United States. Precipitation event samples are collected by cooperating site operators, using specially developed sampling equipment. The concentration data collected over the period July 1, 1977 to July 1, 1978, are listed as a summary of the data reported monthly throughout the year. Samples were chemically analyzed at a central laboratory for 13 pollutant species - pH, conductivity, SO_2, SO_4/sup =/, NH_4^+, NO_2^-, NO_3^-, Cl^-, PO_4^{3-}, Na^+, K^+, Ca^{++}, and Mg^{++} - using ion chromatography, automated wet chemistry, atomic absorption spectrophotometry, and electrode techniques. Second-year developments included: the installation of refrigeration equipment in all Battelle collectors; the initiation of an externally administered quality control program; and use of ion chromatography for cation as well as anion species. Supplementary research efforts included a special collector comparison study at the Pennsylvania State site and further analysis of sulfite versus sulfate deposition.

39573 (UCRL—82549) **MAP3S programs applicable to PEPE's.** MacCracken, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 10p. (CONF-790351—1). Dep. NTIS, PC A02/MF A01.

From EPA seminar and workshop on persistent elevated pollution episodes; Durham, NC, USA (19 Mar 1979).

The MAP3S goal is to improve the capability to simulate the behavior of energy related pollutants in the atmosphere. This requires improving the understanding of atmospheric behavior and of the processes affecting pollutant evolution in the atmosphere. MAP3S has conducted a wide variety of field experiments and characterization studies to improve understanding of wet and dry deposition, pollutant transformation, planetary boundary layer evolution, aerosol speciation, long range pollutant transport, precipitation chemistry, and pollutant budgets. While MAP3S will be continuing in FY-1980 to focus on its own program objectives, the objectives of PEPE (Persistent Elevated Pollution Episode) are sufficiently related to those of MAP3S to permit consideration that some MAP3S resources could be diverted to PEPE studies during limited intensive periods in the summer of 1980. Resources and capabilities that may be available include: network support; field capabilities; and modeling and analysis capabilities. Because of uncertainty in the planning of MAP3S activities for 1980 and beyond, resources in addition to those now available to MAP3S participants may be required. (ERB)

39574 **Determination of ambient H_2SO_4 and it's ammonium salts by in situ aerosol thermal analysis.** Husar, R.B. (Washington Univ., St. Louis, MO). pp 37-40 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

The light scattering component (0.2 to 1.0 μm) of the atmospheric aerosol was thermally analyzed using a nephelometer. Analysis distinguished sulfuric acid from the ammonium salts of sulfates. Thermograms of H_2SO_4, $(NH_4)_2SO_4$, NaCl, and polystyrene latex are presented. Difference in volatilization temperatures allow the specific determination. (PCS)

39575 **Formation and transport of light-scattering aerosols in the St. Louis urban plume.** White, W.H. (Meteorology Research, Inc., Altadena, CA); Blumenthal, D.L.; Anderson, J.A.; Husar, R.B.; Gillani, N.V.; Husar, J.D.; Wilson, W.E. Jr. pp 41-43 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

Results are presented for sulfur and ozone concentrations and movements in and around St. Louis. Observations confirmed laboratory calculations. (PCS)

39576 **Structure, composition and distribution of stratospheric aerosol particles and their radiative properties and importance for the radiation budget.** Cadle, R.D. (National Center for Atmospheric Research, Boulder, CO). pp 116-120 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

Emphasis in this paper centers around aerosol particles' effects on earth's climate by scattering and absorbing radiation in the stratospheric region. Size distributions, composition, concentrations, sources, and optical properties are discussed for sulfuric acid, water vapor, carbon dioxide, sulfur dioxide, carbon monoxide and hydrogen chloride in addition to other trace aerosols. (PCS)

39577 One-dimensional model of the stratospheric aerosol. Hamill, P. (Ames Research Center, Moffett Field, CA); Kiang, C.S.; Toon, O.B.; Turco, R.P.; Whitten, R.C. pp 126-128 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

The one-dimensional model which we describe here was developed as a first step towards a two-dimensional model of the stratospheric aerosol layer. Therefore, transport processes are not included in our model. Nevertheless, the model is interesting in its own right as it predicts aerosol properties in quite good agreement with measured values of observed quantities in the stratosphere. Furthermore, this model takes into consideration most of the chemical and physical processes which affect the layer, so it can be used as a tool to evaluate the relative importance of each of these processes. Finally, within the limitations of any one-dimensional model, it can be used to simulate the effect of perturbations on the layer.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38089, 38287, 38288, 38757, 38758, 38763, 39209, 39549, 39601, 39604

39578 (ANL—78-65(Pt.2), pp 118) **Postprandial changes in the exhalation rate of radon produced in vivo.** Rundo, J.; Markun, F.; Sha, J.Y. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The rate of exhalation of radon by persons with long-standing radium burdens increases about twofold shortly after a meal. The increase is shortlived and normal values are regained in 1.5 to 2 hours. The effect may account in part for the poor reproducibility in estimates of the freely emanating part of the radium content.

39579 (ANL—78-65(Pt.2), pp 119-126) **Postprandial changes in the exhalation of radon from the environment.** Rundo, J.; Markun, F.; Plondke, N.J. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The exhalation of radon originally inhaled from the home environment and dissolved in body fluids and tissues has been studied serially for periods of several hours in six persons. The observation of a pronounced postprandial peak in the rate of exhalation of radon shows that the similar peak observed in the exhalation of radon produced from radium in vivo results from the flushing of a reservoir in soft tissue and not from a change in the fraction lost from bone.

39580 (EML—353) **Appendix to Environmental Measurements Laboratory environmental quarterly.** (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Apr 1979. 229p. Dep. NTIS, PC A11/MF A01.

The report is made up of five appendixes entitled: quarterly ^{90}Sr deposition at world land sites; radionuclides and trace metals in surface air; radiostrontium in milk and tap water; table of conversion factors; and table of radionuclides. Quarterly ^{90}Sr data collected at 77 sites beginning in 1976 are reported. Results of the monitoring of radionuclides and trace metals in surface air (some as early as 1963) are tabulated. Extension information is given on ^{7}Be, ^{54}Mn, ^{89}Sr, ^{55}Fe, ^{90}Sr, ^{95}Zr, ^{109}Cd, ^{137}Cs, ^{141}Cs, ^{144}Ce, ^{210}Pb, ^{238}Pu, and ^{239}Pu. Results of x-ray fluorescence analysis for Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, and Pb are reported. Pb was also determined by atomic absorption analysis. (JGB)

39581 (ORNL—5508) **Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280.** Auerbach, S.I.; Reichle, D.E.; Struxness, E.G. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 212p. Dep. NTIS, PC A10/MF A01.

Separate abstracts were prepared for the ten sections of the report. The report also includes lists of publications, theses, professional activities, and organization charts. (HLW)

39582 (UCRL—52669) **Introduction to self-induced rainout.** Molenkamp, C.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1979. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

Self-induced rainout is the rapid scavenging and deposition of radioactive weapons debris by a precipitating convective cloud. It is caused by detonation of a nuclear weapon. Results from a theoretical calculation using a cloud scavenging model indicate that self-induced rainout can occur in appropriate atmospheric conditions. Observational evidence from Hiroshima and Nagasaki indicate that self-induced rainout may have occurred in those cities.

39583 USERDA effluent data collection and reporting program. Elle, D.R.; Schoen, A.A. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Operational Safety). pp 395-411 of Monitoring of radioactive effluents from nuclear facilities. Vienna; International Atomic Energy Agency (1978).

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

Effluent and environmental monitoring has been conducted at United States Energy Research and Development Administration (formerly United States Atomic Energy Commission) facilities and sites virtually since the inception of atomic energy research and development. In 1971, computer systems were developed that permitted storage of information and data characterizing each effluent and onsite discharge point and relevant information on sources, effluent treatment and control systems, and discharge data, and serve as ERDA's computer-based management information systems for compiling waste discharge control and monitoring data on radioactivity released as airborne or liquid effluents or liquid discharges to onsite retention basins at ERDA facilities. The information systems and associated data outputs have proved to be an effective internal management tool for identifying effluent control problem areas and for surveying an agencywide Radioactive Effluent Reduction Program. The trend data facilitate the detection of gradual changes in the effectiveness of waste treatment systems, and errors or oversights in monitoring and data handling. Other computer outputs are useful for identifying effluent release points that have significantly higher or lower concentrations or quantities in the discharge stream than were measured the previous year. The year-to-year trend reports and the extensive computer edit and error checks have improved the reliability of the reported effluent data. Adoption of a uniform, centralized reporting system has improved the understanding and credibility of effluent data, and has allowed management to evaluate the effectiveness of effluent control practices at ERDA facilities.

39584 Radioactive emanations and the formation and composition of aerosols. Martell, E.A. (National Center for Atmospheric Research, Boulder, CO). pp 44-46 of Radiation in the atmosphere. Bolle, H.J. (ed.). Princeton, NJ; Science Press (1977).

From Symposium of the International Association of Meteorology and Atmospheric Physics; Garmisch-Partenkirchen, F.R. Germany (19 Aug 1976).

Tentative conclusions are presented that the microphysical and chemical processes accompanying α and β^- interactions in air may figure prominently in gas-to-particle conversion processes: (a) in the production and stabilization of small nuclei, (b) in the generation of high concentrations of molecular clusters which speed the coagulation process, and (c) in their influence on the composition and budget of condensation nuclei and Aitken particles. Natural and pollutant α and β^- emitting radioisotopes also may serve as agents of ice nucleation in natural clouds and convective storms. These processes also contribute to the accumulation of hygroscopic constituents on the surfaces of larger airborne particles, enhancing their effectiveness in the growth of large cloud droplets and influencing their radiative properties as well.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38578, 38593, 38594, 38595, 38596, 38597, 38598, 38599, 39622

39585 (PB—284081) **Regional air pollution study: heat emission inventory. Final report.** Littman, F.E.; Griscom, R.W.; Puronen, E. (Rockwell International Corp., Creve Couer, MO (USA). Air Monitoring Center). Jun 1978. Contract EPA-68-02-2093. 67p. NTIS PC A04/MF A01.

As part of the St. Louis Regional Air Pollution Study (RAPS), a heat emission inventory has been assembled. Heat emissions to the atmosphere originate, directly or indirectly, from the combustion of fossil fuels (there are no nuclear plants in the St. Louis AQCR). With the exception of a small amount of energy radiated into space as light, and the energy carried out of the AQCR by cooling water (primarily the Mississippi River), all of the energy released by the combustion of fuels is sooner or later released to the atmosphere as heat, either at the point of production (the power stations) or where it is consumed. This report deals with heat emissions from point sources as well as area sources. Heat emissions from point sources account for about 11 percent in the AQCR. Point source emissions are, however, in the form of concentrated plumes,

while other heat emissions are diffused. Thus, the meteorological dispersion behavior of these sources is likely to be quite different.

39586 (PB—284211) **Chalk Point cooling tower project: chalk point surface weather and ambient atmospheric profile data, September—December 1975.** Meyer, J.H.; Jenkins, W.R. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Jul 1976. 204p. NTIS PC A10/MF A01.

This report is a compilation of the Chalk Point surface weather and ambient atmospheric profile data for the months of September to December 1975. The atmospheric profiles were made using rawinsonde instrumentation. The compilation includes the 0700 EST daily weather chart, hourly surface observations from Chalk Point, Patuxent River Naval Test Center, Maryland and Andrews Air Force Base, Maryland. Temperature, relative humidity, dew point, wind speed and wind direction are presented in graphical profiles. All other data are presented in tabular form.

39587 (PB—284213) **Chalk Point cooling tower project: Chalk Point surface weather and ambient atmospheric profile data; second intensive test period, June 14-24, 1976.** Meyer, J.H.; Jenkins, W.R. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Jan 1977. 728p. NTIS PC A99/MF A01.

This report is a compilation of the Chalk Point surface weather and ambient atmospheric profile data for the second intensive test period, June 14-24, 1976. The atmospheric profiles were made using rawinsonde instrumentation. The compilation includes the 0700 EST daily weather chart, hourly surface observations from Chalk Point, Patuxent River Naval Test Center, MD and Andrews Air Force Base, MD. Temperature, relative humidity, dew point, wind speed and wind direction are presented in graphical profiles. All other data are presented in tabular form.

39588 Prediction methods of cooling tower plumes: Parts I—II. Junod, A. (Swiss Meteorological Inst., Payerne, Switzerland). pp 237-262 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

After reviewing briefly the possible meteorological effects of large heat discharges from cooling towers into the atmosphere, a systematic approach to modelling cooling tower plumes is presented, with particular emphasis on the limits and achievements of the different kinds of models: physical, conceptual, and hydrodynamic. Much attention is devoted to the proper definition of the meteorological data required as input for these models. Moreover the difficult problem of interpreting correctly models output with respect to the general climatological frame is subjected to discussion. The modelling and experimental studies conducted to assess quantitatively the meteorological effects of cooling towers showed that these effects have mostly a local character and that they are small to negligible when integrated over some longer periods of time (month, year). However, further research is needed, both on modelling techniques and experimental impact evaluation.

39589 Cooling tower plume research U.S. Environmental Protection Agency. Shirazi, M.A.; Tichenor, B.A. (Environmental Research Laboratory, Corvallis, OR). pp 263-282 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

A comprehensive review of EPA's cooling tower plume research program is provided with particular attention to plume modeling. The research began in 1969 with a modest effort to define the problem and continued through a multidisciplinary research project at a site where a single cell salt water cooling tower was installed to assess its impact on the local terrestrial ecosystem. The evolutionary process involving the analytical developments and advanced instrumentation techniques required for such undertaking is discussed. Plans for continued efforts are presented.

39590 Calculation of cooling tower plumes with KUMULUS. Brog, P.E. (Motor-Columbus Consulting Engineers Inc., Baden, Switzerland). pp 283-292 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

The goal of the program KUMULUS is the evaluation of the primary nuisances due to cooling tower plumes in the power plant's vicinity. Among them one shall notice the visual impact, the loss of sunshine and luminosity, the water and salt precipitation downwind, the formation of fog, the danger of icing, the influence on the diffusion and settling of emissions from the chimneys of the plant. Up to 100 wet or drywet cooling towers or chimneys or diffusors, arbitrary disposition of the emissions sources and wind direction can be considered. The evaluation of the seasonal mean nuisances at the site is made using the KUMULUS's results for a few hundred meteorological (aerological) representative cases, their frequencies, the windroses and some others climatological weighting's factors. The results of this statistical approach for the meteorological influences at the site are i.e. a family of isolines for the seasonal water and salt precipiation downwind the tower, the seasonal loss of sunshine, the ground fogging (eventually using data from windtunnel measurements). The seasonal frequency of given discrete visual impact, of penetration of inversion layers, the duration and frequency of icing danger can be also be derived from the KUMULUS output and from the statistics. The program KUMULUS and its predecessor SAUNA-S have been used for preparing documents for electrical firms and authorities in Switzerland, Federal Republic of Germany, and occasionally in Belgium. It was also needed to evaluate the modification of the cloud cover above a region with high concentration of power plants equipped with wet cooling towers.

39591 Basic concept of a prediction model for the cooling tower plume. Egler, W.; Ernst, G. (Univ., Karlsruhe, Germany). pp 293-308 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

A set of equations describing the physical processes is presented. Modeling the three-dimensional turbulent motions of the plume is discussed. Special attention is payed to the production of turbulence by buoyancy forces. A simple way for calculating the water content distribution coupled with the enthalpy distribution is proposed. Finally, the model of the cooling tower plume is represented by a system of 17 differential equations.

39592 Heat releases of power plants. Styrikovich, M.A. (USSR Academy of Sciences, Moscow). pp 311-346 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

The effects of increased world energy demands on the environment and, in particular, climate, are discussed. Increases in emissions of CO_2 and SO_2 into the atmosphere are projected, and their effects on climate are discussed. Specific heat releases into water basins and the atmosphere from power plants of different types are tabulated. Various steam condensation heat withdrawal systems are considered, and factors involved in the utilization of waste heat from power plants are discussed. (JGB)

39593 Power production and its potential influence on the global climate. Berkovskii, B. pp 347-364 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

The influence that the fuel-power complex may have on the global climate is discussed. An attempt has been made to estimate the degree of this influence as well as the restrictions on the increase and methods of energy production which will prevent catastrophic changes in the climate. It is shown that the most important influence of the fuel-power complex on the global climate can be made by the following anthropogenic factors: increase in energy production which, through thermal pollution, increases the temperature of the atmosphere at the earth's surface; CO_2 pollution of the atmosphere, decreasing the long wave radiation of the earth; the increase in the concentration of the atmospheric aerosols which reduce the incoming solar radiation. A quantitative estimate of the restrictions on energy production related to thermal, CO_2, and aerosol pollution of the atmosphere is given. First, the main notions of climatology and primary factors of climate formation are exposed, followed by a discussion of the interaction of the fuel-power complex with the biosphere. Attention is then concentrated on the main potential influence of the fuel-power complex on the global climate. A detailed analysis of the restrictions on future energy production and utilization is presented.

REGULATIONS

REFER ALSO TO CITATION(S) 39048, 39564, 39565

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 40050

BASIC STUDIES

REFER ALSO TO CITATION(S) 39606, 39607, 40051

39594 (PB—284164) **Physical management of coastal floodplains: guidelines for hazards and ecosystems management. Report on task 1.** (Conservation Foundation, Washington, DC (USA)). Dec 1977. Contract EQ7AC004. 184p. NTIS PC A09/MF A01.

Development and conservation guidelines for the coastal floodplain are offered in this technical report. Focusing primarily on water systems and water-related aspects of the shoreland, guidelines for nine generalized 'places of concern' have been developed. All nine are distinguishable natural features of the coastal zone. Conservation of coastal ecosystems is one of the two principal objectives of this report. In its consideration of hazards, this report deals only with the maintenance of natural defenses against storms and flooding, not with community preparedness or disaster assistance. Characteristics and boundaries, ecological functions, natural resistance to hazards, environmental problems, potential management responses, and conservation guidelines and restoration technique s are discussed in sequence in subsections on places and features of concern.

39595 (UCLA—12-1190) **Distribution and abundance of soil arthropods in the northern Mojave desert.** Franco, P.J.; Edney, E.B.; McBrayer, J.F. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Mar 1979. Contract EY-76-C-03-0012. 31p. Dep. NTIS, PC A03/MF A01.

Arthropods were extracted from soil samples taken from around four perennial plant species in Rock Valley, Nevada from January to December 1975. The pattern of distribution of the anthropods about the shrubs is described and a model has been constructed to estimate population densities and biomasses. Total arthropod densities ranged from 1600 per m^2 in July to 12,400 per m^2 in December. Total biomass was also lowest in July, 8.7 mg/m^2, and reached 37.2 mg/m^2 in May. The majority of animals collected belonged to the Acari, and of these the Cryptostigmata and the prostigmatid families, Nanorchestidae and Tydeidae, were most abundant. Seasonal variations in the distribution patterns are discussed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38090, 38091, 38892, 38893, 39553, 39561, 39566, 39571, 39618

39596 (AD-A—059512) **Investigation of the environmental consequences of disposal of the lithium organic-electrolyte/SO_2 battery. Final report Sep 76-Jan 78.** Crumrine, K.; Juergens, E.; Colburn, C.; Slimak, M.; Freed, J. (Versar, Inc., Springfield, VA (USA)). Mar 1978. Contract DAAB07-76-C-1752. 123p. NTIS PC A06/MF A01.

This report contains recommendations for disposal of lithium organic-electrolyte/SO2 batteries (standard composition and modified composition) based upon a review of toxicity of battery constituents and laboratory analysis of leachate and solubility tests from cross-sectioned batteries. Laboratory analysis identified an average of 22 mg of cyanide ion per cell in the discharged standard composition cell and 1.6 mg in an undischarged cell. Soil leachate column tests showed significant quantities of cyanide in the leachate from discharged standard composition cells. Disposal recommendations for the standard cell include secured landfills or disposal ponds. Laboratory analysis of solubility tests showed an average of 0.16 mg of cyanide per cell in the discharged modified composition cell. Disposal recommendations for the modified cell are sanitary landfills or the equivalent.

39597 (PB—285072) **Compilation and evaluation of leaching test methods. Final report.** Lowenbach, W. (Mitre Corp., McLean, VA (USA)). May 1978. Contract EPA-68-03-2620. 111p. NTIS PC A06/MF A01.

Under the Resource Recovery and Conservation Act of 1976, EPA is required to promulgate criteria for identification of hazardous wastes. One method of identification is to characterize the leachability of the waste. This study evaluates those factors important to the design of such a test. Additionally, existing leachate tests are compiled and from this listing three tests have been recommended for further evaluation.

39598 (PB—287140) **Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75.** Griffin, R.A.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). Aug 1978. Contract EPA-68-03-0211. 159p. NTIS PC A08/MF A01.

The first part of this project was a laboratory column study of attenuation of pollutants in municipal solid waste landfill leachate by mixtures of sand and calcium-saturated clays. K, NH4, Mg, Si, and Fe were moderately attenuated; and the heavy metals Pb, Cd, Hg, and Zn were strongly attenuated even in columns with small amounts of clay. Precipitation was the principal attenuation mechanism for the heavy metals; cation exchange was responsible for any attenuation of the other elements. The clays, in order of increasing attenuation capacity, were Kaolinite, Illite, Montmorillonite. The second part of the project involved batch studies of adsorption of Cr, Cu, Pb, Cd, Hg, and Zn by Montmorillonite and Kaolinite from water solutions and from landfill leachate. Adsorption of the cations Cr(III), Cu, Pb, Cd, Hg, and Zn increased with increasing pH; adsorption of the anions Cr(VI), As, and Se decreased with increasing pH. Above pH about 5.3 precipitation of the cations was an important mechanism while adsorption was the principal mechanism for the anions over the pH range studied. Because adsorption/mobility of any element was affected by other solutes in leachate, adsorption information on one leachate may not be directly applied to predicting adsorption of the same element at the same concentration in another leachate.

39599 **Microprocessor-controlled inhalation system for repeated exposure of animals to aerosols.** Carpenter, R.L.; Barr, F.P.; Leydig, R.L.; Rajala, R.E. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Enviromental Research Institute, P. O. Box 5890, Albuquerque, New Mexico 87115). *Rev. Sci. Instrum.;* **50**: No. 5, 560-564(May 1979).

A microprocessor-controlled inhalation exposure system (MCIES) has been built to automate aerosol generation and sampling while controlling exposure time for animal toxicity studies. The system has a time resolution of 0.1 s and automatically sequences the exposure events from initiation to temination of the exposure. The operator is required to preset all airflows, read in a paper tape containing the time sequence of events, and initiate the automatic sequence by closing a switch.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38271, 38288, 38757, 38758, 39209, 39580, 39581, 39583

39600 (ANL—78-65(Pt.2), pp 176-194) **Progress report on a study of contamination of the human food chain by uranium mill tailings piles.** Holtzman, R.B.; Urnezis, P.W.; Padova, A.; Bobula, C.M. III. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

A study is in progress to estimate the contamination of the human food chain by uranium, ^{230}Th, ^{226}Ra, ^{210}Pb, and ^{210}Po originating from tailing piles associated with uranium ore processing mills. Rabbits, cattle, vegetables, and grass were collected on or near two uranium mill sites. For controls, similar samples were obtained from areas 20 km or more from the mining and milling operations. For the on-site rabbits the mean ^{226}Ra concentrations in muscle, lung, and kidney of 5.5, 14, and 15 pCi/kg wet, respectively, were substantially higher than those in the respective tissues of control animals (0.4, 1.5, and 0.2 pCi/kg). The levels in liver did not differ significantly between the groups. The concentrations in bone (femur and vertebra) were about 9000 and 350 pCi/kg ash for the on- and off-site animals, respectively. The levels of ^{210}Pb and ^{210}Po did not differ significantly for a given tissue between the two groups. For cattle the existing data indicate that the concentrations of radionuclides do not differ greatly between those grazed near the pile and the controls, except that the ^{210}Pb concentration in the liver of an exposed animal is greater than that of the control. Vegetables from a residential area on a mill site contained substantially greater concentrations of ^{226}Ra and ^{210}Pb than those reported for standard New York City diets.

39601 (CONF-781105—100) **Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc.** Bondietti, E.A. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From ANS meeting; Washington, DC, USA (12 Nov 1978).

Some topics discussed are as follows: speciation behavior of Pu, Np, and Tc; thermodynamic and radiochemical behavior; sorption studies with soils; Pu oxidation states in fresh water; Np oxidation states in soils; effect of oxidation state of Tc on environmental transport predictions; and thermodynamic calculations of Tc speciation. (HLW)

39602 (ORNL—5508, pp 49-64) **Actinide elements in aquatic and terrestrial environments.** Bondietti, E.A.; Bogle, M.A.; Brantley, J.N. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: water-sediment interactions of U, Pu, Am, and Cm; relative availability of actinide elements from abiotic to aquatic biota; comparative uptake of transuranic elements by biota bordering Pond 3513; metabolic reduction of ^{239}Np from Np(V) to Np(IV) in cotton rats; evaluation of hazards associated with transuranium releases to the biosphere; predicting Pu in bone; adsorption—solubility—complexation phenomena in actinide partitioning between sorbents and solution; comparative soil extraction data; and comparative plant uptake data. (HLW)

39603 (ORNL—5508, pp 65-78) **Burial ground technology.** Lomenick, T.F.; Arora, H.S.; Cerling, T.E. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: ^{90}Sr in White Oak Creek between monitoring stations 2 and 3; evaluation of the intermediate-level liquid waste pits and trenches; evaluation of preventive and corrective measures in ORNL solid waste disposal areas; mechanisms of radionuclide-sediment association; hydrologic model development; halocarbons as ground-water tracers; and information services. (HLW)

39604 (PB—283837) **Nuclear facility monitoring in South Carolina.** (South Carolina Dept. of Health and Environmental Control, Columbia (USA). Div. of Radiological Health). Dec 1975. 54p. NTIS PC A04/MF A01.

The United States Nuclear Regulatory Commission (NRC) and the South Carolina Department of Health and Environmental Control entered into a contract whereby the State will perform environmental and in-plant sampling and radiological analysis at designated nuclear facilities within the State licensed by NRC. The Bureau of Radiological Health (BRH) is charged with the responsibility to perform independent measurements of radioactivity in effluents and plant environs. The principal objectives of the contract program are to (1) provide to the NRC reasonable assurance that effluent analyses and environmental measurements made by the nuclear facility under NRC requirements are valid and (2) achieve and maintain traceability to the National Bureau of Standards of the radioactivity measurements made by the licensee, the State and the NRC laboratory involved in this contract. The contract gives BRH authority and responsibility for in-plant sampling of liquid and gaseous radioactive wastes from the facilities, where applicable, and on-site and environmental sampling including air particulate, surface water, potable water, milk, vegetation, soil, and TLD measurements.

SOIL

REFER ALSO TO CITATION(S) 38260, 38287

39605 (PNL—2740) **Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed.** Cataldo, D.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 22p. Dep. NTIS, PC A02/MF A01.

The comparative availability to plants of $^{99}TcO_4^-$ and $^{125}I^-$ in amended Rupert soil and associated subsoil was determined for soils aged after amendment for periods of 1, 10, 30, and 100 days prior to planting. Concentration ratios for cheatgrass (Bromus tectorum) grown on Rupert soil a subsoil amended with $^{99}TcO_4^-$ ranged from 185 to 91 and 466 to 309, respectively; values for tumbleweed (Salsola Kali) ranged from 148 to 82 and 881 to 173 when grown on Rupert soil and subsoil, respectively. Concentration ratios for both cheatgrass and tumbleweed grown on Rupert soil amended with $^{125}I^-$ ranged from 0.95 to 0.25; values for cheatgrass and tumbleweed grown on subsoil ranged from 3.5 to 1.3 and 13 to 5.8, respectively. Analyses of concentration ratios, shoot concentrations, and percentage of spike absorbed indicate a reduction in plant availability of both ^{99}Tc and ^{125}I over the 100-day soil-aging period. This may result from immobilization of $^{99}TcO_4^-$ and anion exchange reactions for $^{125}I^-$.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 39605

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 38093, 38200, 39658

39606 (BNWL-SA—6532) **Diets of mule deer within steppe vegetation of south central Washington.** Uresk, D.W.; Uresk, V.A. (Battelle Pacific Northwest Labs., Richland, WA (USA); Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). 1978. Contract EY-76-C-06-1830. 21p. (CONF-780261—1). Dep. NTIS, PC A02/MF A01.

From Meeting of the Society for Range Management; San Antonio, TX, USA (5 Feb 1978).

The diets of mule deer (Odocoileus hemionus hemionus) on shrub-steppe rangeland of south central Washington were estimated by microhistological examination of fecal pellets. On rangelands, it is necessary to know the diets of herbivores and availability of forage plants to provide information for formulating better management programs for both plants and animals. The purpose of this study was to determine the dietary habits of mule deer at three locations on the 200 area plateau of the Hanford Reservation in south central Washington. The study area has not been grazed by livestock since 1943, but small mammals such as the black-tailed hare (Lepus californicus) and ground squirrels (Citellus townsendi) do feed there.

39607 (DOE/EV—2307-15) **Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963—1975.** Beatley, J.C. (Cincinnati Univ., OH (USA). Dept. of Biological Sciences). Mar 1979. Contract EY-76-S-02-2307. 57p. Dep. NTIS, PC A04/MF A01.

The shrub, tree, and cactus vegetation of 59 selected study sites in eight drainage basins of the Nevada Test Site was documented in 1963, and again in 1975. Vegetation of the sites, which span the range of 3076 to 7425 ft elevation, is assigned to five plant associations, and intergrades, on the 25 Mojave Desert sites; eight associations on the 10 Great Basin Desert sites; and six associations, and ecotonal types, on the 24 sites of the desert transition. The data presented are for numbers of plants crossing the lines, mean height of plants, and calculated percentage cover of the ground. All data are summarized by site, species, and year for each of the vegetation categories, and for living and dead plants combined and dead plants only. Apparent from the data are increases in the numbers, height, and percentage cover on nearly all sites, and in essentially all species, during the 12-year period, and a decrease in the proportions of dead plants. Species composition or relative proportions of the species did not change. The increases appear to be directly related to rainfall during the time interval. It is concluded that in desert vegetation numbers and size of shrubs vary significantly with climatic fluctuations through time, and reflect especially the rainfall history of a given site at any point in time.

REGULATIONS

REFER ALSO TO CITATION(S) 39048

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 40050

BASIC STUDIES

REFER ALSO TO CITATION(S) 40051

39608 (COO—2003-T1) **Nutrient enrichment and eutrophication of Lake Michigan. Progress report, November 1, 1975—September 30, 1978.** Schelske, C.L. (Michigan Univ., Ann Arbor (USA). Great Lakes Research Div.). 1978. Contract EY-76-S-02-2003. 20p. Dep. NTIS, PC A02/MF A01.

This progress report begins with a summary of research activities during the past three years and ends with eleven appendices as supplemental reference materials. In the following summary, brief narratives were prepared integrating the reports under the following headings: nearshore processes, mixing and water transport, phytoplankton nutrient enrichment experiments, and ecosystem analyses. The purpose of the summary is to point out the significance of research efforts with reference to broader environmental questions than those which have been studied. The appended materials are in various stages of completion, ranging from reports which have been published, manuscripts which have been submitted for publication and manuscripts which are being readied for publication.

39609 (PB—285410) **The West Indian manatee (Trichechus manatus) in Florida: a summary and analysis of biological, ecological, and administrative problems affecting preservation and restoration of the population. Final report.** Wray, P. (Mitre Corp., McLean, VA (USA). METREK Div.). Sep 1978. Contract MM8AD054. 91p. NTIS PC A05/MF A01.

The population of the West Indian manatee (Trichechus manatus), an endangered species, is estimated at 800-1,000 individuals in peninsular Florida. Observed annual mortality between 1974 and 1977 was 6-8% of the estimated population. Human activities are implicated in much of this mortality. Direct and indirect threats include boat collisions, diver harassment, creation of artificial warm water refuges, vandalism, entanglement in fishing gear, herbicides in food resources, and possible effects of offshore oil exploration. Lack of federal commitment to manatee protection is evidenced by an absence of implementing regulations under the Marine Mammal Protection Act and the Endangered Species Act, absence of a recovery plan for the species, faulty interagency communication, and a lack of law enforcement. Problems are discussed, with recommendations for conservation. (Color illustrations reproduced in black and white)

39610 **Horizontal undependability in the planktonic environment.** Star, J.L.; Mullin, M.M. (Univ. of California, San Deigo, La Jolla). *Mar. Sci. Commun.;* 5: No. 1, 31-46(1979).

During July 1977, horizontal transects of temperature and chlorophyll were taken from a depth of approximately 34 m in the central North Pacific Ocean and in the nearshore region off southern California. The variance spectra from both areas were similar. Spectral analysis suggests a small and constant variability between wavelengths of 45 m and 600 m. Cross-spectral computations show no coherence between chlorophyll and temperature in this band. From the viewpoint of an individual herbivore, this describes an environment which is physically and nutritionally undependable.

RADIOMETRIC TECHNIQUES

39611 (DOE/EV—75027-58) **Preliminary report, R/V Thomas G. Thompson cruise TT-122.** Peterson, W.K. (Washington Univ., Seattle (USA). Dept. of Oceanography). Nov 1977. Contract EY-76-S-06-2225-027. 13p. (RLO—2225-T26-58). Dep. NTIS, PC A02/MF A01.

A cruise to collect information on the processes affecting phytoplankton production and distribution during summer along a shelf-slope section off the Washington coast, and to gain information on the settling rate of organic matter in the sea, was successfully completed in August 1977. This report contains a brief synopsis of the cruise (TT-122) aboard the R/V THOMAS G. THOMPSON.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38090, 38162, 38163, 38170, 38171, 38199, 38202, 38224, 38599, 38892, 38893, 38951, 39351, 39553, 39561, 39562, 39564, 39566, 39567, 39571, 39597, 39694

39612 (BNL—25114) **General considerations on how rainwater must obtain sulfate nitrate and acid.** Newman, L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790415—4). Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

Some general statements and observations are made concerning SO/sub x/ and NO/sub x/ emissions in connection with the ratio that appears in aerosols, and the concentrations found in ambient air and rainwater. Based on these considerations and the acidity of aerosols and rainwater it can be concluded that it does not appear possible for rainwater to obtain its sulfur and nitrogen from aerosol sulfate and nitrate both because the ambient concentrations of the aerosols are too low and the acidity is insufficient to account for that found in rainwater. In contrast it was shown that rainwater must obtain an appreciable fraction of its sulfur and acidity by incorporation of sulfur dioxide and that the nitrogen and its acidity could come from either nitrogen dioxide or nitric acid. Inferences can be made that in-cloud processes must be important for this incorporation of the sulfur or nitrogen dioxides. Finally it was shown that the average oxidation rate of sulfur dioxide in the atmosphere must be of the order of 0.5% per hour. The importance of making nitric acid and ammonia concentration measurements in the atmosphere are clearly indicated along with in-cloud measurements of the species in question.

39613 (DP—1512) **Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility.** Kiser, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1979. Contract EY-76-C-09-0001. 44p. Dep. NTIS, PC A03/MF A01.

Upsets in the operation of the wastewater strippers in the 400 Area of the Savannah River Plant have released hydrogen sulfide in quantities as large as 1800 kg to the effluent stream. Fish kills in the swamp area of Beaver Dam Creek have occurred following the large releases. A literature survey revealed volatilization and oxidation as the major loss mechanisms of H_2S. Laboratory investigations supported the literature survey. The computer code for pollutant transport in a stream, LODIPS, has an option to account for sink-source effects in a stream. Volatilization and oxidation rate constants were developed for the sink option from two H_2S releases (18 kg and 118 kg) and results were predicted with LODIPS. Based on the predicted concentration-time profiles for various hypothetical cases, releases as small as 568 kg if discharged over a 30-minute period or releases as large as 1818 kg if discharged over a 360-minute period or less are lethal to swamp fish.

39614 (IVL-B—445) **Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey.** Landahl, C.C.; Lindestroem, L. (Swedish Water and Air Pollution Research Lab., Stockholm). Jun 1978. 12p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

The biological components of different water systems have been studied in order to detect pollutions. In this connection the chironomid larvae have been found useful as indicators. The influence of organic elements on several species is well known, while more knowledge is necessary about the influence of mineral oils and/or heavy metals. A literature survey is given of what is known hitherto about which species of the chironomid larvae that have a high sensitivity to oils and metals.

39615 (ORNL—5508, pp 24-35) **Ecosystem Studies Program.** Van Hook, R.I.; Allen, T.; Allison, L.J. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Research activities of the systems analysis project consisted of the following: succession modeling; error analysis of nonlinear systems; and spatial heterogeneity. Fuels from woody biomass were studied with regard to the following: species selection; stand establishment; silvicultural treatment; and harvesting. Progress is also reported on the following: material spiralling in stream ecosystems, and global carbon dioxide. (HLW)

39616 (PB—284013) **Effects of the disposal of coal waste and ashes in open pits. Final report.** Libicki, J. (Central Research and Design Inst. for Open-Pit Mining, Wroclaw (Poland)). Apr 1978. 299p. NTIS PC A13/MF A01.

The objective of this study was to determine the extent of groundwater quality deterioration when coal mine solid waste (refuse) and power plant ashes were disposed of into open pits. In addition, disposal methods were developed and procedures for planning and designing disposal sites were formulated. Pilot studies were conducted at two experimental disposal sites, at which the groundwater was monitored. As backup to these tests, laboratory studies of the physical-chemical properties of the waste, and its leachate were conducted. Based upon the results of these studies, a full scale demonstration was conducted. From this work, the physical-chemical character of the waste material and its susceptibility to leaching of particular ions in a water environment were determined, as was the influence of precipitation on the migration of pollutants (TDS, Cl, SO4, Na, K, Ca, Mg, NH4, PO4, CN, phenols, Cd, Sr, Cu, Mo, and B) to the aquifer. The level of pollution of groundwater in the vicinity of disposal sites and its dependence on local hydrogeological conditions, and particularly on hydraulic gradients was ascertained. Recommendations for improved waste storage technology in order to limit the effect on groundwater to a minimum and guidelines for designing a monitoring system are presented. (Portions of this document are not fully legible)

39617 (PB—285646) **Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report.** Pollack, A.M.; Stolzenbach, K.D. (Massachusetts Inst. of Tech., Cambridge (USA). Ralph M. Parsons Lab. for Water Resources and Hydrodynamics). Jun 1978. 330p.

The Argo Merchant oil spill on Nantucket Shoals (Massachusetts) in December 1976, was the focus of a massive scientific investigation. More than 200 scientists were involved in predicting and studying the fate and effects of the spill, at a cost exceeding $800,000. The report outlines three reasons scientists might want to take action following a spill and points out that previous post-spill activities have been somewhat less than successful in meeting these goals. The scientific work following the Argo Merchant spill is then reviewed as a case study of such post-spill science. The story of how the scientific response developed is told more or less chronologically and the scientific quality of the various endeavors evaluated.

39618 (PB—285805) **The Amoco Cadiz oil spill. A preliminary scientific report. Special report.** Hess, W.N. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Environmental Research Labs.). Apr 1978. 355p.

A preliminary account of the United States (EPA and NOAA interagency oil spill response team) scientific efforts in response to the Amoco Cadiz oil spill during the period March 19 to May 15, 1978 is provided. Approximately 64,000 tons of oil came ashore

along 72 km of the shoreline of Brittany during the first 2 1/2 weeks of the spill. A prevailing westerly wind pushed the oil against west-facing headlands and into shoreline embayments as it moved east. A wind reversal in early April moved the oil in the opposite direction, contaminating previously untouched areas. Coastal processes and geomorphology played a major role in the dispersal and accumulation of the oil once it came onshore. Studies include: Physical processes; Chemical composition of selected environmental and petroleum samples from the Amoco Cadiz oil spill; Investigations of beach processes; Biological observations; Oil spill cleanup activities; Chronology; Colored plates.

39619 (PB—286217) **Mining and mineral fuel development in the Montana statewide 208 study area: implications to water quality. Final report.** Schmidt, J.; Botz, M.K. (Montana Dept. of Health and Environmental Sciences, Helena (USA). Water Quality Bureau). 1 Mar 1978. 198p. NTIS PC A09/MF A01.

Mining of mineral commodities and mineral fuels has touched virtually every major drainage basin in western and central Montana. With the discovery of natural gas in the eastern portion of the Rockies, and an expanded potential development of bentonite and lignite in eastern Montana, mining has become of significance to the whole state. The objectives of this project are to assess the significance of existing mining related impacts to water quality, assess future mining developments in the state, assess the adequacy of existing statutes and their administration, and develop management strategies to correct old problems and avoid future problems. This investigation evaluates the extent of past, present, and future mining development in the 42 county Statewide 208 Study Area of Montana. Thirty-six mineral commodities, as well as four mineral fuels, are evaluated as to their development potential. Specific and general water quality impacts associated with mining and mineral fuel developments are examined. Specific mining impacts are cited, based on a comprehensive interview program conducted throughout the Statewide 208 Area.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38089, 38288, 38757, 38758, 39209, 39580, 39581, 39583, 39601, 39602, 39603, 39604

39620 (ORNL—5508, pp 79-91) **Aquatic Ecology Section.** Brocksen, R.W.; Adams, S.M.; Barnthouse, L.W. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Population studies included the following: empirical transport model of the impact of entrainment on fish; impingement losses of white perch in the Hudson river; and modeling the effects of entrainment on adult fish. Progress is also reported on the following: sediment contribution to the accumulation of ^{60}Co and ^{137}Cs in fish; dose rate and the frequency of abnormal embryos in Gambusia; distribution and concentration of tritium in White Oak Lake; stable element concentrations in fish; toxicant formation in condenser cooling systems; and environmental monitoring of aquatic systems. (HLW)

WATER

REFER ALSO TO CITATION(S) 38224, 38287

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38599

39621 (ORNL—5508, pp 17-23) **Cooling Systems Program.** Coutant, C.C.; Adams, S.M.; Anderson, D.J. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following research projects: Corbicula studies; mayfly studies; temperature selection by striped bass in Cherokee reservoir; temperature selection by smallmouth bass in Lambert quarry; rates of heat exchange in largemouth bass; growth efficiencies of juvenile striped bass as a function of temperature and ration; a model for size dispersion in growth of juvenile fish; pathogenic amoebae in cooling waters; ecological ramifications in a southeastern reservoir; and entrainment. (HLW)

39622 **Thermal effluent disposal from power generation.** Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978). 383p. (CONF-7608130—). The Publisher, 1025 Vermont Ave., NW, Washington, DC.

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Papers are presented on methods of heat disposal and techniques of engineering analysis and design necessary for their implementation as well as the evaluation of their environmental effects. The papers are included in one of the following categories: thermal discharges in the aquatic environment, thermal discharges in the atmosphere, and thermal discharges and climate. Each of the eighteen papers is abstracted and indexed individually. (JGB)

39623 **Hydrothermal modeling techniques associated with waste heat disposal.** Harleman, D.R.F.; Jirka, G.H.; Stolzenbach, K.D. (Massachusetts Inst. of Tech., Cambridge, MA). pp 3-10 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Techniques for estimating natural and induced water temperature variations associated with open cycle power plant condenser cooling systems are discussed as to the waste heat management and regulatory frameworks within which these techniques have found application in the United States.

39624 **Entrainment solutions for jet discharge into deep water.** Abraham, G. (Delft Hydraulics Lab., Netherlands). pp 11-44 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

In most jets it is possible to distinguish subdomains with known entrainment behavior. The entrainment concept explained in Section 1, gives information on the entrainment within the subdomains to be expanded to cover the whole jet. Section 2 gives a derivation of entrainment expressions for the subdomains. Section 3 gives entrainment solutions for jets issuing into stagnant fluid. Section 4 gives entrainment solutions for jets in flowing ambient fluid. The limits of the entrainment concept are given in Section 5.

39625 **Evaluation of integral and phenomenological models for heated surface plumes with field data.** Policastro, A.J.; Dunn, W.E. (Argonne National Lab., IL). pp 45-60 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Several validation efforts carried out on the popular integral and phenomenological models for heated surface discharges are reviewed. It is found that these models can provide only general estimates of plume characteristics; precise predictions are not possible. There are basically two reasons for the poor performance of the integral models. First, they are too idealized, neglecting many of the phenomena which are important in plume dispersion (boundary interferences, wind, transient effects). Second, the phenomena that are considered are often poorly simulated relying on intuitive or unproven hypotheses. The phenomenological models also fail to provide accurate predictions, because they are developed from a limited data base which does not permit proper inclusion of the controlling factors in many real world sites. An improved state-of-the-art can best be achieved by pursuing numerical (finite-difference) modeling as well as basic laboratory studies of plume dispersion to better understand plume physics.

39626 **Numerical modeling of surface thermal plumes.** Policastro, A.J.; Dunn, W.E. (Argonne National Lab., IL). pp 61-98 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

An overview of the state of the art of thermal-plume modeling by numerical techniques is given. Concepts, rather than the specific details of individual formulations, are emphasized. The body of the paper is divided into four sections. The first section addresses the important assumptions made when translating the physics of thermal plumes into mathematical terms. This section includes, among other things, a discussion of the often-used hydrostatic approximation and the several techniques of modeling turbulence within a thermal plume. In the second section, various numerical-modeling philosophies are considered. Specific algorithms are used here to illustrate the nature of these philosophies as well as how they are implemented in practice. The third section summarizes existing model validation efforts, with particular attention to identifying areas of needed improvement. Unfortunately, many of the comparisons so far attempted have been poorly executed. Typically, too small a grid was used or the turbulence parameters were poorly chosen. Additionally, the data selected for comparison have often been incomplete or of poor quality. In the final section, key numerical-modeling issues are discussed and specific models are presnetly in

what might be called the germination stage and that these models hold great promise for the future.

39627 General three-dimensional models for thermal pollution analysis. Lee, S.S. (Univ. of Miami, Coral Gables, FL); Sengupta, S.; Bland, R.A. pp 99-114 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

A generalized mathematical model package (including rigid lid and free-surface models) that is being developed for analyzing thermal discharges is described. The need for three-dimensional complete models for thermal pollution analysis is evident. The package developed has given satisfactory results for widely varying topography and discharge configuration. However, there is a need for further work to establish verification at different sites, with varying discharge geometry and meteorological conditions.

39628 Three-dimensional numerical model for hydrothermal analysis of cooling ponds. Vasiliev, O.F. (Institute of Hydrodynamics, Novosibirsk, USSR). pp 115-132 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

A brief analysis is made of the modern state of theoretical research of the hydrothermal behaviour of cooling ponds. Two mathematical models are suggested of unsteady hydrothermal processes in shallow water ponds taking into account the stratification in the Boussinesq approximation: one model with and the other without considering horizontal turbulent exchange. A method of numerical realization of the latter model is briefly described and some results of practical computations are reported.

39629 Two-dimensional numerical models for hydrothermal analysis of water bodies. Vasiliev, O.F. (Institute of Hydrodynamics, Novosibirsk, USSR). pp 133-150 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Possibilities of reducing a three-dimensional hydrothermal model of water bodies to two-dimensional ones are discussed. Two two-dimensional models are described: one with depth averaging, the other with width averaging. A computation algorithm is given for the second model with two examples of computation: (1) for thermally stratified flow occurring as warm water is discharged into a relatively narrow water body of oblong form; (2) for density flow occurring in a channel at a sudden withdrawal of a vertical gate separating the fluids of different densities.

39630 Thermal loading of river systems. Zimmermann, C. (Lahmeyer International GmbH, Frankfurt am Main, Germany); Geldner, P. pp 175-194 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

The purpose of heat load computations, to show the limitations for additional heat loads from new power plants, was fully satisfied. It was demonstrated that for the given temperature standards due to the existing meteorological and discharge conditions all German rivers have already reached their limits or will come to these within a few years. Due to the extremely critical assumptions in these computations the final closure date is presumably postponed for some time but it has already been shown that once-through cooling without supplemental cooling for all nuclear power stations because of their size is no more possible. Therefore all new power stations are built only with cooling towers, although once-through cooling for more than 50% of a year might be possible. Main reasons are the independent control of the cold end in the generating process and the fact that cooling water which is polluted already upstream of the power stations causes considerable problems in cooling towers and therefore needs to be treated so that costs mostly prevent furnishing of both cooling systems. There are, however, considerations on the basis of discussed heat transport capacity of a river to give guidelines on time and duration of cooling tower operation for selected power stations on the Rhine River that have already built both systems.

39631 Monitoring of thermal effluents: measurement techniques and selected field results. Dinelli, G. (ENEL, Milano, Italy). pp 195-226 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

The purpose of thermal effluent mapping of power plant stations is to determine the diffusion boundaries of the higher (+ 8 divided by 12°C) temperature water discharged into receiving water by mapping the water's surface and subsurface temperature. This can be done by a combination of aerial infrared surveys and ground surveys each of which techniques complements the other. Airborne infrared campaigns are conceived to gather general information for a better understanding of the movement of heated water after rejection at the outfall of thermal power plants, to investigate the correlation of surface temperature measured by conventional ground surveys with temperature obtained by infrared airborne techniques and to delineate the circulation pattern, mixing effect, and the extent of the regions affected by the heated waters. In general, results from infrared surveys show a reasonable agreement with quasi-simultaneous in situ temperature measurements. From measurements conducted in Italy (on coastal and inland waters), at nadir a fixed error of only 2 to 4°C was noted in the radiant temperatures due to atmospheric absorption depending on the flight altitude. For practical appliations a maximum and minimum in situ temperatures of the water surface as well as atmospheric temperature and humidity and wind velocity should be recorded for calibration purposes. These measurements would primarily account for the variable atmospheric attenuation of the radiometric temperatures and the gradient in water temperature occurring in the top 0.2 cm of water. This should permit the realization of absolute temperature mapping to within 0.5°C. In addition, a vertical temperature gradient should be determined in the water near the point of discharge. Preferably this should be done at several points since the boundary change to the well-mixed zone is often abrupt.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 38880, 38881, 38882, 38883, 38884, 38885, 38886, 38951

39632 (PB—283848) **Historical, physical, and chemical limnology of Twin Lakes, Colorado.** Sartoris, J.J.; LaBounty, J.F.; Newkirk, H.D. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Sep 1977. 102p. NTIS PC A06/MF A01.

The study is an attempt to quantify the impacts of construction and operation of a pumped-storage powerplant on a montain lake environment by means of detailed investigations of the pre- and post-operation limnology of Twin Lakes, Colorado. This report covers a 5-year study of the preoperation physical and chemical limnology of the lakes and includes a summary of earlier limnological work. Twin Lakes are a pair of second-class dimictic, connected, montane, drainage lakes of glacial origin. Chemically, Twin Lakes are soft, dilute calcium bicarbonate lakes with large accumulations of heavy metals, including iron, manganese, zinc, copper, and lead, in the bottom sediments. During periods of thermal stratification, hypolimnetic oxygen may become depleted to such an extent that reducing conditions at the sediment-water interface allow significant quantities of these metals to diffuse into the water column.

REGULATIONS

REFER ALSO TO CITATION(S) 39048, 39564

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 38159, 38168, 38169, 38366, 38874

39633 (N—78-28671) **Considerations on some economic and environmental problems related to energy production, part 3.** (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 21 Dec 1976. 43p. NTIS PC A03/MF A01.

Environmental and energetic aspects of the transportation system in the U.S. are considered. Topics dealt with under the theme - energy use: the petrochemical industry - include substitution of natural products by synthetic products, environmental and energetic consequences, nondegradable toxic substances and high energy cost, and the economic origins of petrochemical technology.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 38348, 38757, 38758, 39568

39634 (PB—283787) **Energy supply and environmental impacts conventional sources, study module III-A. Technical Appendix. Code users manual (final).** McFadden, J.H. (Northwest Energy Policy Project, Portland, OR (USA)). 1978. 122p. NTIS PC A06/MF A01.

The study proper examines in detail the future supplies and prices of all forms of energy consumed in the Pacific Northwest (electricity, natural gas, petroleum, and coal) through the year 2000. Sets of alternative assumptions on the availability, price, and use of these forms of energy are used to develop scenarios leading to low, moderate, and high rates of growth in supply and demand. Quantified estimates of the environmental impacts likely to occur at each rate of growth are given. This technical appendix contains the code users manual, the environmental impact coefficients, and sample problems in natural gas, petroleum, coal, and electricity. (Portions of this document are not fully legible)

ENVIRONMENTAL IMPACT STATEMENTS

39635 (DOE/EA—0063) **Allocation of petroleum feedstock: Northern Illinois Gas Company, Aux Sable SNG Plant, Grundy County, IL.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Dec 1978. 187p. Dep. NTIS, PC A09/MF A01.

A request was made to the Department of Energy from North Illinois Gas Company (NI—Gas), for an increased volume and long term assignment of feedstocks for use in production of SNG at its Aux Sable plant near Morris, Illinois. A study was made to assess the degree to which the requested allocation, if granted, would constitute a major federal action which would significantly affect the quality of the human environment within the meaning of section 102 (2) (c) of the National Environmental Policy Act of 1969 (NEPA). This environmental assessment (EA) will be used as a basis for determining whether an Environmental Impact Statement (EIS) is required or whether a negative determination is appropriate. The discussion is presented under the following section headings: description of proposed action; description of environment affected by proposed action; anticipated environmental impacts of alternative feedstock assignments; impact summary and comparison of feedstock assignment alternatives; summary of irreversible and irretrievable commitment of resources; summary and comparison of short term use of environment vs. long term productivity; summary of alternatives to feedstock assignment; and, summary of considerations offsetting adverse effects of proposed action. An appendix is included. (JGB)

BIOMEDICAL SCIENCES, BASIC STUDIES

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 39049, 39649, 39652, 39668

39636 Absorption spectrum of actinomycin D. Evidence for three transitions in the visible band. Auer, H.E. (Univ. of Rochester, NY); Pawlowski-Konopnicki, B.E.; Krugh, T.R. *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **73**: No. 2, 167-170(Feb 1977).

In order to gain a more thorough understanding of the interaction between actinomycin and DNA, Krugh and his coworkers have examined simple model systems comprised of actinomycin D (AMD) and selected mono- and dideoxynucleotides, primarily by absorption and NMR spectroscopies. Pawlowski-Konopnicki and Krugh are investigating these same systems using circular dichroism (CD) spectroscopy. The CD spectra of AMD were examined over a broad range of concentrations and at several temperatures in aqueous buffer. The dimerization of AMD is apparently complicated by the formation of higher aggregates at millimolar concentrations. Accordingly, spectra of the dimer were calculated from the experimental data using known values of the dimerization constant. A temperature-dependent transformation in the structure of the dimer was found, corroborating earlier observations. The pattern of CD bands which emerges indicates that the intense visible absorption band of the actinocinyl chromophore is comprised of at least three different electronic transitions. One is centered at about 372 nm under the short-wave shoulder of the absorption envelope; a second occurs in the range 415 to 445 nm in the vicinity of the absorption maximum; a third, found at about 490 nm under the long-wave tail of the absorption spectrum, is most likely strongly associated with the quinoid ring of the chromophore.

39637 (UR—3490-1569) **Does DNA have two structures in solution that coexist at equilibrium.** Lozansky, E.D.; Sobell, H.M.; Lessen, M. (Rochester Univ., NY (USA)). 1978. Contract EY-76-C-02-3490. 15p. Dep. NTIS, PC A02/MF A01.

The existence of two discrete structures for different regions of DNA at equilibrium in solution is postulated. These structures correspond to B DNA and to an inelastically deformed DNA structure, denoted β kinked DNA. β kinked DNA corresponds to a second order phase transition in the polymer, different regions of DNA undergoing this transition at different temperatures, and arises from a specific normal mode oscillation in DNA structure that is excited by Brownian motion of solvent molecules. It is possible that these multiply-kinked premelted regions play an important role in RNA polymerase—promoter recognition.

39638 (UR—3490-1578) **Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12—24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein.** Owens, M.R.; Miller, L.L. (Rochester Univ., NY (USA). School of Medicine and Dentistry; Saint Mary's Hospital, Rochester, NY (USA). Dept. of Medicine). 1978. Contract EY-76-C-02-3490. 27p. Dep. NTIS, PC A03/MF A01.

Antithrombin III- heparin cofactor has been isolated from normal rat plasma, purified to homogeniety on acrylamide gel electrophoresis and used to prepare a monospecific antiserum in rabbits. Measurements of rat AT-III were made by a single radial immunodiffusion assay. Net synthesis of AT-III was investigated during 12 or 24 hour perfusions of the isolated rat liver. In perfusions performed under basal conditions cumulative synthesis of AT-III was observed to occur at a rate sufficient to replace the total circulating plasma AT-III in about 6 hours. In perfusions performed under full supplementation conditions which greatly enhanced synthesis of fibrinogen and α-2 (acute phase) globulin (known acute phase reactant proteins) net synthesis of AT-III was not significantly greater than that observed in control perfusions. Although these prolonged perfusion studies conclusively demonstrate net synthesis of AT-III by the isolated rat liver, they afford no evidence that this protein is an acute phase reactant.

39639 Relationship of hemoglobin synthesis to erythroid colony and burst formation. Eliason, J.F.; Van Zant, G.; Goldwasser, E. (Franklin McLean Memorial Research Inst., Chicago, IL). Contract EY-76-C-02-0069. *Blood;* **53**: No. 5, 935-945(May 1979).

We have demonstrated that the cyclohexanone method for the extraction of hematin can be used to measure hemoglobin synthesis induced by erythropoietin (epo) in mouse bone marrow cells cultured in medium containing methyl cellulose. The time course of hemoglobin synthesis by mouse marrow cells showed two effects due to epo: an increase in hemoglobin synthesis at day 2, which corresponded to the formation of small erythroid colonies resulting from the CFU-E (colony-forming unit, erythroid); and a very large increase in hemoglobin synthesis, which was maximal at days 7 to 8 and corresponded to the formation of large erythroid colonies (bursts) resulting from the BFU-E (burst-forming unit, erythroid). The epo dose-response curves for CFU-E colony counts and day-2 hemoglobin synthesis were similar, and the cell-number—response curves for these two parameters were parallel. The epo dose-response curve for BFU-E colony counts reached a plateau at an epo concentration between 3 and 5 units/ml, whereas the dose-response curve for 6- to 8-day hemoglobin synthesis did not reach a plateau even at an epo dose of 10 units/ml.

39640 Competition between erythropoietin and colony-stimulating factor for target cells in mouse marrow. Van Zant, G.; Goldwasser, E.; Pech, N. (Franklin McLean Memorial Research Inst., Chicago, IL). Contract EY-76-C-02-0069. *Blood;* **53**: No. 5, 946-965(May 1979).

We have assessed the effects of erythropoietin (epo) and colony-stimulating factor (CSF) on mouse bone marrow cells in vitro. When pure human urinary epo, at a dose that maximally stimulated erythroid burst formation, was added to cultures along with increasing amounts of CSF, two types of competitive effect were evident. Epo caused suppression of the number of granulocyte—macrophage (G-M) colonies formed because of low concentrations of CSF; at higher CSF levels, as the number of G-M colonies increased, erythroid burst formation was suppressed. Increasing amounts of CSF caused dose-dependent suppression of epo-induced hemoglobin synthesis. Complete suppression was found at a concentration of CSF that was within the linear portion of the log-dose-log-response curve for CSF-dependent G-M colony formation using the same pool of marrow cells. Competition was found only in cultures at relatively high cell densities. Epo caused suppression of CSF-induced G-M colonies, and CSF caused suppression of 8-day hemoglobin synthesis, when there were more than 1×10^5 marrow cells per milliliter. Relatively high cell concentrations may be re-

quired so that mechanisms important in regulating hemopoietic differentiation can be studied in vitro.

39641 Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite. Simmons, R.R.; Friedberg, E.C. (Stanford Univ., CA). *J. Bacteriol.;* **137**: No. 3, 1243-1252(Mar 1979).

A number of mutants of Escherichia coli defective in the ung gene (structural gene for uracil-deoxyribonucleic acid [ura-DNA] glycosylase) are shown to be abnormally sensitive to treatment with sodium bisulfite when compared with congenic ung$^+$ strains. These results provide further evidence that sodium bisulfite causes the deamination of cytosine to uracil in DNA and that ura-DNA glycosylase is required for the repair of U-G mispairs. The effect of the chemical is apparently selective with respect to base damage; coliphages containing cytosine in their DNA are inactivated by treatment with sodium bisulfite, whereas those containing hydroxymethylcytosine are not. ura-DNA glycosylase and the major apurinic-apyrimidinic endonuclease of E. coli may function in the same repair pathway, since the extent of inactivation of a congenic set of strains which are ung xth (structural gene for the major apurinic-apyrimidinic endonuclease of E. coli) or ung xth$^+$ is the same.

39642 Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N′-nitro-N-nitrosoguanidine. Billen, D.; Hellermann, G.R. (Oak Ridge National Lab., TN). *J. Bacteriol.;* **137**: No. 3, 1439-1446(Mar 1979).

Deoxyribonucleic acid polymerase I-directed repair synthesis can be selectively measured in toluene-treated Escherichia coli cells exposed to alkylating chemicals such as N-methyl-N′-nitro-N-nitrosoguanidine. Prior growth of the cells in the presence of a low dose of N-methyl-N′-nitro-N-nitrosoguanidine results in an enhanced deoxyribonucleic acid polymerase I-directed repair synthesis and an increase in single-strand breaks.

39643 Asymmetry of apolipoprotein A-I in solution as assessed from ultracentrifugal, viscometric, and fluorescence polarization studies. Barbeau, D.L.; Jonas, A.; Teng, T.; Scanu, A.M. (Univ. of Chicago, IL). *Biochemistry;* **18**: No. 2, 362-369(23 Jan 1979).

The solution properties of apoliporprotein A-I (apo A-I) isolated from human and rhesus monkey serum highdensity lipoproteins were examined by the techniques of fluorescence polarization, sedimentaion velocity, sedimentation equilibrium, and viscometry as a function of protein concentration. The ultracentrifugal studies confirmed previous reports that human and rhesus monkey apo A-I undergo a concentration-dependent, reversible self-association in aqueous solutions. The sedimentaion velocity data, extrapolated to infinite dilution, indicated that the apo A-I monomer is asymmetric, with an axial ratio of about 6. The reduced viscosity of apo A-I solutions was also markedly affected by protein concentration; within the range of concentrations studied, the values for human apo A-I ranged from 11.19 to 21.24 mL/g and for rhesus apo A-I, from 8.26 to 16.83 mL/g. The intrinsic viscosity, 6.58 mL/g, of the apo A-I monomer was significantly higher than that of a typical globular protein (3-4 mL/g); the axial ratio, 5.5, was in agreement with that obtained from the ultracentrifugation analyses. In the fluorescence polarization studies, human and rhesus apo A-I were dansylated to the extent of 1.0 to 2.5 mol of dansyl group/mol of apo A-I. This chemical modification was attended by no appreciable change in the secondary structure of apo A-I, as assessed by circular dichroism spectra. The apparent sedimentation coefficient, molecular weight, and rotational relaxation time of each of the dansylated proteins indicated that both human and rhesus monkey apo A-I self-associated to a lesser extent than the unmodified apo A-I. At protein concentrations ranging from 0.002 to 3.0 g/L, the fluorescence polarization values of dansylated apo A-I remained essentially constant (0.185 to 0.192), although rotational relaxation times indicated self-association at the higher concentrations.

39644 Transposition of plasmid DNA segments specifying hydrocarbon degradation and their expression in various microorganisms. Chakrabarty, A.M.; Friello, D.A.; Bopp, L.H. (General Electric Research and Development Center, Schenectady, NY). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 7, 3109-3112(Jul 1978).

The conjugative TOL plasmid (75 Mdal), specifying biodegradation of xylenes, toluene, and trimethylbenzene derivatives, undergoes dissociation in Pseudomonas aeruginosa PAO to a nonconjugative TOL* plasmid (28 Mdal) and a transfer plasmid termed TOLΔ (48 Mdal). The TOL* plasmid is rendered transmissible through introduction of a number of conjugative plasmids such as factor K, CAM, and TOLΔ but not by the FP2 derivative pR0271. Transfer of TOL* via factor K or TOLΔ is mediated by the formation of plasmid cointegrates; no recombination is observed with CAM. A recombinant RP4-TOL plasmid (76 Mdal), which has lost resistance to tetracycline, has been isolated. The TOL* segment can be transposed from this RP4-TOL recombinant plasmid to other antibiotic resistance plasmids such as R702. A segment of DNA, specifying salicylate degradation from SAL plasmid, was transposed onto pAC10, the TOL^{*-} derivative of RP4-TOL recombinant plasmid, which has lost resistance to tetracycline but retains the transfer genes of RP4. Transposition of the salicylate degradative genes onto pAC10 results in the loss of kanamycin resistance. It has been possible to isolate SAL$^+$ segregants from pAC10::SAL transposition derivatives that have lost the pAC10 plasmid. Such segregants harbor the salicylate degradative genes in the form of a nonconjugative plasmid (SAL*). Transfer of RP4::TOL* or pAC10::SAL* transposition derivatives to Escherichia coli, Salmonella typhimurium, Agrobacterium tumefaciens, or Azotobacter vinelandii results in the functional expression of the antibiotic resistance genes but not of the hydrocarbon degradative genes. Such genes, however, are fully expressed on being transferred back to Pseudomonas.

39645 Mechanism of suppression in Drosophila. VII. Correlation between disappearance of an isoacceptor of tyrosine tRNA and activation of the vermilion locus. Jacobson, K.B. (Oak Ridge National Lab., TN). *Nucleic Acids Res.;* **5**: No. 7, 2391-2404(Jul 1978).

The possibility that tyrosine tRNA modifies the catalytic activity of tryptophan oxygenase that is produced by the vermilion mutant (v) in Drosophila melanogaster is reconsidered. Dietary conditions can modify the ratio of the two major isoacceptors of tyrosine tRNA: one condition allows 85 to 90% to exist as the second isoacceptor, and another condition allows <5% to exist in this form. The function lacking in the vermilion mutant is partially restored when the second isoacceptor of tRNA/sup Tyr/ is reduced to low levels (<40%), but the function is greatly reduced when this isoacceptor is present at 50% or more of the total. These data support the hypothesis that tRNA/sup Tyr/ may be associated with and regulate tryptophan oxygenase. The corresponding isoacceptor of tRNA/sup Tyr/ found in a suppressor mutant, su(s)^2, should not have any effect on the function of the vermilion gene, and indeed, it did not. The tRNAs for tyrosine, aspartic acid, and histidine all have one isoacceptor that contains nucleoside Q and all undergo parallel changes in flies raised on the various diets. It appears that these dietary changes affect the ability to synthesize or modify Q or to remove or insert it into tRNA.

39646 Prevention of G:C pairing in mouse DNA by complete blocking of guanine residues with glyoxal. Availability of cytosine, adenine and thymine for hydrogen bonding with added unmodified polynucleotides. Birnboim, H.C.; Mitchel, R.E.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Biochim. Biophys. Acta;* **517**: 296-307(1978).

Birnboim and Mitchel, have developed conditions for the reaction of single-stranded DNA with glyoxal which permit blocking of essentially all guanine residues. This procedure effectively prevents base pairing involving these guanine residues, yet permits cytosine, thymine and adenine residues in the DNA to pair with added polynucleotides. Modification of DNA with glyoxal greatly reduces intrastrand helical regions, resulting in a very low binding to hydroxyapatite, as compared to unmodified DNA. Annealing of modified DNA with some synthetic polynucleotides of restricted composition (but not others) leads to a significant increase in binding, presumably because mouse DNA has sequences not containing guanine which are capable of hydrogen bonding to the added polynucleotides. This relatively simple procedure may allow isolation and further study of these guanine-free sequences in DNA.

39647 Quantitation by flow microfluorometry of total cellular DNA in Acanthamoeba. Coulson, P.B.; Tyndall, R. (Univ. of Tennessee, Knoxville). *J. Histochem. Cytochem.;* **26**: No. 9, 713-718(1978).

The DNA content of five speciea of Acanthamoeba was determined by flow microfluorometry. Acanthamoeba castellanii (AC-30), acanthamoeba polyphaga (APG and P-23), acanthamoeba rhysodes, acanthamoeba culbertsoni (A-1), and acanthamoeba royreba were grown in a casitone based medium 24 to 48 hr. The trophozoites were harvested, fixed in 70% ethanol (acidified), pretreated with RNase, stained with propidium diiodide, and evaluated for DNA-bound fluorescence. All species tested had DNA values between 2.0 to 5.0 pg/cell. These results placed DNA/cell values of Acanthamoeba slightly lower than DNA/cell values of other eucaryotic cells and much lower than Amoeba proteus values. These results indicate that FMF may be a useful adjunct in distinguishing Acanthamoeba cells from either eucaryotic cells or some other amoeba. However, differences in DNA/cell between species of Acanthamoeba are small and would not be useful in identification of species.

39648 Qualitative alterations in plasma esterases in BALB/c mice following the administration of diethylnitrosamine. Davidson, K.A.; Tyndall, R.L.; Clapp, N.K. (Oak Ridge National Lab., TN). *Chem.-Biol. Interact.;* **21**: 19-27(1978).

Selected non-specific plasma esterases in female BALB/c mice, separated by polyacrylamide gel electrophoresis, were qualitatively altered following treatment of the mice with diethylnitrosa-

mine (DEN). These alterations include a decreased preference for naphthyl butyrate as a substance relative to naphthyl acetate; decreased sensitivity to enhancement by divalent cations such as Ca^{2+}, Mg^{2+}, and Mn^{2+}; ad an increased sensitivity to inhibition by eserine. All esterase species affected were also quantitatively altered and some were testosterone-dependent.

CYTOLOGY

REFER ALSO TO CITATION(S) 39669, 39700

39649 (UR—3490-1480) **Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction.** Kostuk, R.K.; Muhs, A.G.; Kirkpatrick, F.H.; Gabel, C.W. (Coast Guard Research and Development Center, Groton, CT (USA); Rochester Univ., NY (USA)). 1977. Contract EY-76-C-02-3490. 28p. Dep. NTIS, PC A03/MF A01.

A unique optical instrument is described which uses the firefly bioluminscent reaction to measure adenosine triphosphate (ATP) levels in single red blood cells. The method allows chemical content level to be associated with individual cell features. The optical instrument consists of a phase contrast microscope to view cells, a pulsed argon-ion laser to rupture the cell membrane, and a photon counting system to measure the bioluminescent yield. The technique has been calibrated against a standard ATP measurement using bulk analysis methods. The ATP loss mechanism for blood cells in a controlled depletion experiment was also investigated.

39650 (UR—3490-1553) **Improved histochemical methods for the examination of plastic-embedded human marrow.** Moosavi, H.; Lichtman, M.A.; Donnelly, J.A.; Churukian, C.J. (Rochester Univ., NY (USA). Dept. of Pathology). [nd]. Contract EY-76-C-02-3490. 23p. Dep. NTIS, PC A02/MF A01.

Improved methods for processing, sectioning, and staining plastic (glycol methacrylate) embedded human marrow biopsies are described. Marrow biopsies processed by this technique were compared with biopsies processed by the conventional paraffin embedding method. The plastic-embedded marrows provide better morphology enhancing diagnostic accuracy, permit assessment of bone as well as marrow, and allow histochemical analysis of biopsy specimen. Special stains including naphtol AS-D chloroacetate esterase, periodic acid Schiff (PAS), reticulin, and iron have been modified so that they are suitable for undecalcified, two microns thick, plastic-embedded human marrow biopsies.

GENETICS

REFER ALSO TO CITATION(S) 39644, 39659

39651 **Genetic modification and plant productivity.** Carlson, P.S. (Michigan State Univ., East Lansing). pp 107-112 of Energy from biomass and wastes. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from biomass and wastes; Washington, DC, USA (14 Aug 1978).

Novel techniques are currently being developed for genetic modification of higher plants. These include cellular manipulations which allow mutant isolation and hybrid production, and recombinant DNA techniques. The usefulness of these techniques for increasing plant productivity is unclear. The primary limitation of their use is a lack of information concerning the biological processes which underlie plant productivity.

MEDICINE

REFER ALSO TO CITATION(S) 39650

39652 (PB—284092) **Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976.** Nyilas, E.; Chiu, T-H.; Turcotte, L.R. (Avco-Everett Research Lab., Everett, MA (USA)). Oct 1977. Contract N01-HV-3-2917. 125p.

Studies on the noncompetitive interaction energetics and mechanism of native human plasma proteins with surfaces foreign to blood were continued, using well-characterized microparticulate adsorbents prepared from glass (GP), a procoagulant, as well as relevant biomaterials such as pure and silicon-alloyed low temperature isotropic carbons (LTIC and SLTIC, respectively). Experimental techniques involved solution adsorption, direct microcalorimetric heat of sorption and electrophoretic mobility measurements. Consistent with results obtained at 25C, the 37C integral net heats of sorption of fibrinogen (FGN, clottability > 92%) were greater on GP than on LTIC by factors of 5-10. The analytical model postulated earlier for the 25C sorption mechanism of FGN on GP was found to be applicable at 37C as well. Entropy data derived for FGN molecules directly attached to GP surfaces strongly imply substantial degrees of adsorption-induced structural alterations. A series of experiments was initiated to elucidate the energetics of native plasma protein sorption on microparticulate adsorbents under competitive conditions, using fresh human platelet poor plasma and serum. The state of water adjacent to LTIC and SLTIC surfaces, which can affect protein sorption energetics, has been characterized in terms of standard thermodynamic functions indicating the presence of a low surface number density of heterogeneous active sites.

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 39664

EXTERNAL RADIATION IN THERAPY

39653 (HRP—0018641) **Criteria and standards, for megavoltage radiation therapy installations.** (Southern Piedmont Health Systems Agency, Inc., Charlotte, NC (USA)). Jan 1977. 6p. NTIS PC A02/MF A01.

This paper is an outline of facts to be studied when planning the installation of megavoltage therapy equipment -- e.g. linear accelerators, cobalt-60 units, betatrons, Van de Graaf generators, etc. To justify purchase, each proponent institution should treat 300 to 400 new patients per year and perform 25 to 35 treatments per day unit of equipment. In addition, the personnel using the equipment should consist of a board-certified radiation therapist or general radiologist with special training in megavoltage radiation; board-certified eligible physicians in nuclear medicine, hematology with expertise in chemotherapy and immunotherapy, and endocrinology; and trained radiotherapy technicians. Before purchasing a new unit, applicants should present the number of current out-referrals for radiation therapy, the average number of treatments per day, hours per day of operation of existing equipment, the average number of patients on the waiting list and the impact of the new unit on utilization of existing equipment. Also to be considered are: total capital expenditures for the installation of a megavoltage unit, sources of funding or terms of leases, an estimate of the cash value of the equipment based on a 5 year projection of revenue and expenses associated with the unit and the expected useful life of the equipment.

39654 (HRP—0900241) **Planning guide for radiologic installations -- fascicle ha, basic concepts, layout considerations.** Tuddenham, W.S. (American Coll. of Radiology, Chicago, IL. Committee of Dept. Planning). 1977. 108p. Available from American College of Radiology, 6900 Wisconsin Ave., Chevy Chase, MD 20015.

This collection of articles focuses on the problems of layout and spatial and equipment distribution in the radiology department of a health care facility. The articles included provide multiple viewpoints toward the problems to permit a range of options to architects, engineers, hospital planners and radiologists involved in planning radiologic facilities. Information from countries other than the U.S. is included as are data provided by x-ray equipment manufacturers and architectural firms. Some of the issues addressed include future trends and factors influencing radiology, preplanning considerations, efficiency of a vertical department of radiology, decentralization of the radiology department, radiology in an ambulatory care setting, and functional zoning and modular coordination for facilities. References, graphs, diagrams and layout patterns are included in the text. The aim of this fascicle is to meet the need of frequent revision of a rapidly changing technology to keep planners abreast of changes and developments in radiologic equipment, installation and layout design. This fascicle is an extension of Fascicle 4 which discusses basic issues such as estimation of size of a radiologic facility, spatial distribution of departmental functions and shielding requirements.

39655 (NTISUB/D/294—009) **Clinical and preclinical aspects, of bone tumors and soft tissue sarcomas. Special listing.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 31 Jul 1978. 21p. NTIS PC A02/MF A01.

The Special Listing of Current Cancer Research Projects is a service of the International Cancer Research Data Bank (ICRDB) program of the National Cancer Institute. Each listing contains descriptions of ongoing projects in one selected cancer research area. The research areas include: Diagnosis and prognosis of bone and soft tissue sarcomas; Therapy of bone tumors and other sarcomas; Broad clinical programs and cooperative group studies; Bone tumor registries and related epidemiological studies.

39656 (NTISUB/D/294—011) **Radiotherapy, nuclear medicine, radiologic diagnosis and related techniques. Special listing.** (National

Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 25 Aug 1978. 51p. NTIS PC A04/MF A01.

The Special Listing of Current Cancer Research Projects is a service of the International Cancer Research Data Bank (ICRDB) program of the National Cancer Institute. Each listing contains descriptions of ongoing projects in one selected cancer research area. The research areas include: Radioisotope, heavy particle and other ionizing radiation therapy of cancer; Combination of radiotherapy with chemotherapy, immunotherapy or hyperthermia; Radiation dosimetry and dose fractionation studies; Effect of radiotherapy on non-target tissues and on host immunity; New techniques and equipment for cancer radiotherapy; Computer-assisted treatment planning for cancer radiotherapy; Special radiotherapy procedures; Broad cancer radiotherapy programs, including education and services; New methods with potential for the radiologic diagnosis of cancer; Ultrasonography and thermography in the detection of breast and other cancer; Diagnosis of cancer by x-radiography; Use of radioisotopes in the diagnosis of cancer--isotope preparation, scanning equipment, and methodology; Radioisotope scintigraphy of cancer in specific body sites; Other studies in diagnostic radiology, including education and training.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 38324, 39049, 39659

PATHOLOGY

REFER ALSO TO CITATION(S) 39700, 39702

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 39555, 39700, 39702

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 38130

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 39555, 39566, 39651

39657 (PNL-RAP—33) **Projected energy and water consumption of Pacific Northwest irrigation systems.** King, L.D.; Hellickson, M.L.; Schmisseur, W.E.; Shearer, M.N. (Oregon State Univ., Corvallis (USA)). Oct 1978. Contract EY-76-S-06-2227-025. 207p. (RLO—2227/T25-3). Dep. NTIS, PC A10/MF A01.

A computer model has been developed to predict present and future regional water, energy, labor, and capital requirements of irrigated agricultural production in Idaho, Oregon, and Washington. The energy requirements calculated were on-farm pumping, and total energies. Total energies are the combined energies of on-farm pumping, manufacture, and installation. Irrigation system selections and modifications were based on an economic analysis utilizing the following input parameters: water, energy, labor, and capital costs and requirements; groundwater and surface water pumping lifts; improved application efficiencies; and pumping plant efficiencies. Major conclusions and implications of this analysis indicate that: as water application efficiencies increases additional quantities of water will not become available to other users; an overall increase in water application efficiencies resulted in decreases in gross water applications and increases in overall on-farm pumping and total energy consumptions; more energy will be consumed as pumping and total energies than will be conserved through decreased diversion pumping energy requirements; pump-back and similar technologies have the potential of both increasing application efficiencies and energy conservation; and the interrelationships understood between applying water in quantities greater than required for crop consumptive use and leaching, and late season in-steam flow augmentation and/or aquifer recharge are not well understood, and sound policy decisions concerning agricultural use of water and energy cannot be made until these interrelationships are better understood.

39658 (SRO—0870-5) **Comparison of sludge and fertilizer applications on establishment and growth of seedlings of two sweetgum ecotypes endomycorrhizal with Glomus mosseae and G. etunicatus. Establishment and progress report.** Kormanik, P.P. (Forest Service, Athens, GA (USA). Southeastern Forest Experiment Station). Dec 1978. Contract EY-76-A-09-0870. 6p. Dep. NTIS, PC A02/MF A01.

Half-sib progeny from two sweetgum (Liquidambar styraciflua) mother trees endomycorrhizal with Glomus etunicatus and G. mosseae were grown in the Forest Service's experimental nursery located near Athens, Georgia, and outplanted on SRP, at Aiken, South Carolina, in late February 1978. Sludge and fertilizer treatments were applied to the plots several weeks prior to planting. Nutrient equivalence to the 1/4" sludge standard was approximated with the addition of diammonium phosphate, ammonium nitrate, and hydrated lime. Two soil moisture lysimeters (one at an effective sampling depth of 38" and one at 10") were installed in the middle of each plot after planting of seedlings to follow nutrient cycling on site. Soil moisture will be monitored monthly during the growing season and nitrogen equivalence among the sludge and fertilizer treatments will be maintained by adding ammonium nitrate to half of the fertilizer plots when such adjustments are needed as determined in the laboratory. A first-year progress report will be prepared after field data is collected in December 1978.

BIOMEDICAL SCIENCES, APPLIED STUDIES

IN MICROORGANISMS

REFER ALSO TO CITATION(S) 39659

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

39659 (UR—3490-1568) **Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast.** Friedman, L.R.; Sobell, H.M. (Rochester Univ., NY (USA)). [nd]. Contract EY-76-C-02-3490. 16p. Dep. NTIS, PC A02/MF A01.

We have examined radiation-induced mitotic recombination using two alleles (his1-36, his1-49) in the his1 gene. When the haploid containing his1-36 is irradiated with varying doses of γ rays and then mated with the unirradiated strain containing his1-49, analyses of the selected prototrophs show them to be primarily + +/+ 49. If, on the other hand, the haploid strain containing his1-49 is the irradiated parent, the prototrophic diploids are primarily + +/36 +. In control experiments, where either both strains are irradiated or not irradiated, no such asymmetries are found. These data indicate that the irradiated haploid chromosome tends to be the recipient of genetic information. We interpret these results as indicating a directional bias in the formation of hybrid DNA in radiation-induced mitotic recombination, and discuss these results in terms of current models of genetic recombination.

RADIATION EFFECTS ON ANIMALS

MAN

39660 (ABCC-TR—73-74) **Atomic Bomb Casualty Commission. Annual report, 1 July 1973—30 June 1974.** (Radiation Effects Research Foundation, Hiroshima (Japan); Radiation Effects Research Foundation, Nagasaki (Japan). Nagasaki Branch). 1974. 81p. (In English and Japanese). Dep. NTIS, PC A05/MF A01.

Progress is reported on the following research projects: basic radiation estimates and evaluation; genetic and cytogenetic studies; neoplasia studies; aging and mortality studies;epidemiological studies of specific diseases and metabolic processes and other physiological phenomena. The report also includes lists of publications and oral presentations, administration operations, community relations, and scientific conferences. (HLW)

39661 (ANL—78-65(Pt.2), pp 70-79) **Reduction of patient dose delivered by CHR diagnostic x-ray examinations.** Evans, R.D.; Schlenker, R.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Three changes in technique have been made which reduce the x-ray dose delivered by diagnostic examinations of patients of the Center for Human Radiobiology (CHR): Kodak Lanex Regular screens and Kodak Ortho G film have been substituted for DuPont Cronex Parspeed screens and DuPont Cronex 4 film for five projections in the MIT examinations; 3 mm Al added filtration is now used in place of 1 mm Al added filtration in the ANL examination; improvements in collimation for the ANL examination have been made. Use of the new screen-film combination at MIT has reduced the mean dose to the active marrow of the female RANDO phantom

from 606 +- 69 mrad to 235 +- 16 mrad; it has reduced the ovary dose from 606 +- 40 mrad to 291 +- 19 mrad and has left the breast dose unchanged at 333 +- 103 mrad. The change from 1 mm Al to 3 mm Al added filtration at ANL, without changes in collimation, would reduce the mean marrow dose in the phantom from 232 +- 14 mrad to 175 +- 26 mrad, reduce the ovary dose from 243 +- 25 mrad to 162 +- 38 mrad and reduce the breast dose from 388 +- 35 mrad to 226 +- 9 mrad. The changes in collimation at ANL should reduce these doses even further but the quantitative effect has not been ascertained.

39662 (NUREG—0093(Rev.1)) **Radiological emergency response planning: Handbook for Federal Assistance to State and Local Governments.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs). Dec 1978. 87p. Dep. NTIS, PC A05/MF A01.

The handbook is directed toward those federal agencies involved in providing direct field assistance to state and local governments in radiological emergency response planning. Its principal purpose is to optimize the effectiveness of this effort by specifying the functions of the following federal agencies: Nuclear Regulatory Commission, Environmental Protection Agency, Department of Energy, Department of Health, Education, and Welfare, Department of Transportation, Defense Civil Preparedness Agency, Federal Disaster Assistance Administration, and Federal Preparedness Agency. (HLW)

39663 (NUREG—0495) **Public meeting on radiation safety for industrial radiographerss: remarks, questions and answers at five NRC regional meetings.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Nov 1978. 68p. NTIS, PC A04/MF A01.

Over the past several years thenumber of radiation overexposures experienced in the radiography industry has been higher than for any other single group of NRC licensees. To inform radiography licensees of NRC's concern fo these recurring overexposure incidents, NRC staff representatives met with licensees in a series of five regional meetings. At these meetings the staff presented prepared remarks and answered questions on NRC regulations and operations. The main purposes of the meetings were to express NRC's concern for the high incidence of overexposures, and to open a line of communication between the NRC and radiography licensees in an effort to achieve the common goal of improved radiation safety. The remarks presented by the staff and subjects discussed at these meetings included: the purpose, scope, findings and goals of the NRC inspection program; ways and means of incorporating safety into radiography operations; and case histories of overexposure incidents, with highlights of the causes and possible preventions. At each of the regional meetings the staff received a request for a copy of the prepared remarks and a consolidation of the questions and answers that were discussed. This document includes that information, and a copy is being provided to each organizaion or firm attending the regional meetings. Requests for other copies should be made in accordance with the directions printed inside the front cover of this document.

39664 (PB—285628) **Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978.** Gilkey, A.D.; Manny, E.F. (Bureau of Radiological Health, Rockville, MD (USA)). Jul 1978. 54p. NTIS PC A04/MF A01.

The publication is designed to allow a quick review of recent journal articles on the topic of patient selection for x-ray examination. The articles are organized under the four main subtopics: Efficacy, Utilization, Radiation Effects, and Radiation Protection. Within each subtopic, the articles follow a chronological order. To aid in a more specific review of a subject, a convenient index of terms has been included for user reference. The standard format contains the title of each article, the author, journal, volume, page, date, and abstract.

39665 (STI/PUB—471(Vol.2)) **National and international standardization of radiation dosimetry. Volume II.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1978. 382p. (CONF-771209—P2). IAEA $31.00.

From IAEA symposium on national and international standardization of radiation dosimetry; Atlanta, GA, USA (5 Dec 1977).

Eight papers were presented on basic physical aspects of dosimetry. Some topics discussed were: theoretical aspects of electron and photon dosimetry; high-energy radiation dosimetry; calibration of dosemeters; wall effects in gamma-ray dosimetry; and correction factors in gamma-ray dosimetry. Five papers were presented on standardization and calibration of radioactive sources. Some topics discussed were: calibration of whole-body counters for measuring Pu; and multi-technique characterization of neutron fields from moderated ^{252}Cf and $^{238}PuBe$ sources. Nine papers were presented on absorbed dose determinations. Some topics discussed were: a technique to compensate for geometry-induced errors in a photon irradiator calibration; general cavity theory in the dosimetry of x rays; method of energy determination for electron accelerators; and gamma-ray dosimetry errors with thermoluminescent dosemeters. (HLW)

39666 **Visual phenomena induced by relativistic carbon ions with and without Cerenkov radiation.** McNulty, P.J. (Clarkson College, Potsdam, NY); Pease, V.P.; Bond, V.P. *Science;* **201**: No. 4353, 341-343(28 Jul 1978).

Exposing the human eye to individual carbon ions ($^{6}C^{+}$) moving at relativistic speeds results in visual phenomena that include point flashes, streaks, and larger diffuse flashes. The diffuse flashes have previously been observed by astronauts in space but not in laboratory experiments with particles of high atomic number and energy. They are observed only when the nucleus moves fast enough to generate Cerenkov radiation.

VERTEBRATES

REFER ALSO TO CITATION(S) 39293

39667 (BNL—25730) **Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice.** Carsten, A.L.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 11p. (IAEA-SM—237/45; CONF-790325—7). Dep. NTIS, PC A02/MF A01.

From International symposium on biological implications of radionuclides released from nuclear industries; Vienna, Austria (26 Mar 1979).

There is concern over the possible late effects resulting from chronic exposure to tritiated water, a primary by-product of power reactors. We are comparing the genetic and somatic effects of tritiated water ingestion to acute x-ray or chronic cesium-137 gamma-ray exposures. Eight week old mice were maintaned on tritiated water in concentrations of 0.3, 1.0, and 3.0 μCi/ml. Identical animals received cesium-137 gamma exposures equivalent to that from the tritiated water. At 4 week intervals, animals were sacrificed and the hematopoietic stem cell content and cellularity of the bone marrow determined. For comparison of acute and chronic effects, one group of mice received a single whole-body x-ray exposure of 525 rads. The x-irradiated animals showed an immediate sharp decrease in marrow cellularity followed by gradual return to normal levels, with a lifelong reduction in number of marrow stem cells. Animals exposed to the two higher concentrations of tritiated water showed only slight reductions in marrow cellularity, with a lifelong reduction in hematopoietic stem cells in the bone marrow. Comparison of the external gamma exposures to chronic tritiated water ingestion indicates similar patterns. Maintenance of normal cellularity with a reduced number of stem cells in x-rayed animals was shown by tritiated thymidine cytocide to be due to the reduction in number of stem cells in the resting G/sub O/ stage. At this time it is not possible to determine whether there is a significant difference in relative biological effectiveness of tritiated water compared to cesium-137 gamma rays; however, indications are that they are similar.

39668 (COO—2012-38) **Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968—December 31, 1978J.** Kinsey, V.E.; Reddy, V.N. (Oakland Univ., Rochester, MI (USA). Inst. of Biological Sciences). 1978. Contract EY-76-S-02-2012. 14p. Dep. NTIS, PC A02/MF A01.

As indicated in the scope and purpose of this program, the broad aim of these investigations was to provide an understanding of the mechanisms by which various inorganic ions and a number of organic substances, particularly amino acids, enter and leave the ocular lens and to assay the role of these mechanisms in the physiological and pathological conditions of the eye. The studies also dealt with the mechanisms of glutathione in the lens and its relationship to amino acid transport, the effect of x-ray on the protein aggregation mechanism as well as the studies of the biochemical changes associated with the development of the experimentally induced galactose cataract.

39669 (UCRL—52000-79-3, pp 7-16) **Monitoring environmental exposures with semen assays.** Mar 1979.

In Energy and technology review.

Semen studies in humans and animals have yielded extensive and compelling evidence that sperm can be used to assess reproductive potential and diagnose pathology. More recent studies on mutagens and carcinogens both at this and other laboratories suggest that a combination of mouse and human assays can be an efficient, effective approach to monitoring for reproductive hazards in the environment. We are investigating the potential of using variability in sperm morphology and DNA content to quantify and monitor the effects of environmental agents on the human testes. Here we review the status of human and mouse assays for environmental surveillance, discuss the genetic and fertility implications of chemically

induced semen changes, and describe the high-speed flow methods being developed to automate sperm assays.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 39665

39670 (ANL—78-65(Pt.2)) **Radiological and Environmental Research Division annual report, July 1977—June 1978.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 281p. Dep. NTIS, PC A13/MF A01.

Separate abstracts were prepared for the 27 sections of the report. Appendices are included on exposure data for radium patients and radium-induced malignancies. (HLW)

39671 (ANL—78-65(Pt.2), pp 1-4) **Recent cases of radium-induced malignancy.** Brues, A.M. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Five cases of malignant disease attributed to radium in patients with measured body burdens have been discovered since 1974, including three bone sarcomas and two mastoid carcinomas. Pertinent findings in these cases are summarized here.

39672 (ANL—78-65(Pt.2), pp 5-6) **Radium-induced malignant tumors of the mastoid and paranasal sinuses.** Littma, M.S.; Kirsh, I.E.; Keane, A.T. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

In the records of 5058 persons with therapeutic or occupational exposure to radium, 21 patients with carcinoma of the mastoid and 11 with malignant tumors of the paranasal sinuses were identified. Induction time for mastoid tumors was 21 to 50 years, median 33; for paranasal sinus tumors it was 10 to 52 years, median 34. Dosimetric data are given for the patients whose body burdens of radium have been measured. Observations and theoretical considerations strongly suggest that radon in the air of sinuses may be an important or perhaps a major factor in the induction of paranasal sinus malignancies in the radium cases.

39673 (ANL—78-65(Pt.2), pp 7) **Dose-response relationships for female radium dial workers.** Rowland, R.E.; Stehney, A.F.; Lucas, H.F. Jr. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Among 1474 women employed in the U.S. radium dial painting industry before 1930, there are 61 known cases of bone sarcoma and 21 cases of carcinoma of the paranasal sinuses or the mastoid air cells (head carcinomas). The relative effectiveness of ^{226}Ra and ^{228}Ra and dose-incidence relationships were examined for the 759 of these women whose radium body burden has been determined; there are 38 cases of bone sarcoma and 17 cases of head carcinoma in this group.

39674 (ANL—78-65(Pt.2), pp 8) **Survival times of women radium dial workers first exposed before 1930.** Stehney, A.F.; Lucas, H.F. Jr.; Rowland, R.E. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Life table methods were applied to survival data on U.S. women radium dial workers in order to compare observed and expected deaths as a function of time after exposure to radium. The study population consisted of 1235 workers employed in the industry before 1930 for whom age and year of death, withdrawal, or loss from the study were known. Expected deaths were estimated from age- and time-specific death rates for U.S. white females.

39675 (ANL—78-65(Pt.2), pp 9-19) **Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship.** Lloyd, E.L.; Henning, C.B.; Gemmell, M.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Cells lining bone surfaces are thought to be the cells at risk for the production of bone tumors by alpha particle emitters, such as ^{226}Ra and ^{239}Pu. Hence, precise measurement of the size and location of these cells relative to bone mineral is necessary for meaningful dose vs. risk estimates in man. The nuclear dimensions of these lining cells in normal adult human bone were measured in the present study by means of techniques which left the surface layer of cells well preserved and in contact with normal undecalcified bone. The cells, which were found to be flattened, had an average length (+- S.E.) of 7.84 +- 0.22 μm and an average width of 1.8 +- 0.8 μm. This particular geometry in conjunction with the direction of the radiation arising from bone mineral may favor malignant transformations over cell killing and may profoundly affect the shape of the dose-response relationships. As shown by others, the distended nature of these cells may provide proliferative advantages for the eventual development of tumors. These results taken together provide further evidence that the direct action of alpha radiation on the nuclei of flattened cells at bone surfaces appears to be the most likely initiating event for the induction of bone tumors.

39676 (ANL—78-65(Pt.2), pp 43-54) **Lymphoblastogenesis in response to phytohemagglutinin in radium patients: quantitative aspects and reproducibility.** Serio, C.S.; Henning, C.B.; Lloyd, E.L. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Lymphocyte stimulation by different concentrations of phytohemmagglutinin (PHA) provided a profile of lymphocyte responsiveness in 5 normal subjects and 40 radium dial painters. This profile will, hopefully, improve detection of lymphocyte defects in patients with impairment of cellular immunity. When a suboptimal dose (0.15 μg PHA-protein) was used, decreased lymphocyte responsiveness was observed in patients with high body burdens of ^{226}Ra (> 0.1 μCi) compared with patients with low body burdens (< 0.1 μCi) and normal subjects. At all other PHA concentrations, the lymphocyte responsiveness was not significantly different in these three groups. A decrease in lymphocyte response was found with age in both normal controls and in the radium patients, but the decrease appeared to be somewhat greater in the radium patients above 50 years of age. To test the significance of these findings, larger numbers of control subjects in the higher age groups and low body burden radium patients known not to be on any type of medication will have to be examined.

39677 (ANL—78-65(Pt.2), pp 55-69) **Quantitative histology of human paranasal sinus and mastoid air cell epithelia.** Harris, M.J.; Schlenker, R.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

A study was made of epithelial cell populations in the paranasal sinuses and mastoid air cells and their relationship to bone surface to provide a basis for practical microdosimetric calculations.

39678 (ANL—78-65(Pt.2), pp 80-94) **Analysis of thick source alpha particle spectrum from radium and its daughters in bone.** Mausner, L.F.; Schlenker, R.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The alpha particle energy spectrum of ^{226}Ra and its four alpha emitting daughters in an ashed, ground bone sample has been resolved into its components using a computerized spectrum stripping algorithm. These calculated results have been compared to direct measurements of the ^{226}Ra and ^{214}Po distributions obtained by alpha—gamma coincidence techniques. The ability of the calculation to deconvolute the total spectrum into its five alpha components implies that straightforward alpha counting may be used instead of the very low efficiency ^{226}Ra alpha—gamma coincidence method. From knowledge of the actual ^{226}Ra distribution, along with suitable detector energy and efficiency calibrations, one could determine endosteal cell dose rate empirically.

39679 (ANL—78-65(Pt.2), pp 95-108) **Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results.** Rundo, J.; Holtzman, R.B.; Sha, J.Y. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Data on ^{226}Ra and calcium in samples of bone from 41 females who died from 1 to 53 years after exposure to radium have been subjected to preliminary analysis. The data for 86 samples from 26 femora show that there is a tendency for the ^{226}Ra/Ca ratio (normalized to the terminal ^{226}Ra body content) in any part of the femur to increase with time of death after exposure, but no progressive changes of distribution between cancellous bone (at the ends) and cortical bone (shaft) can be demonstrated. Direct comparisons are made between predictions of the ICRP model of alkaline earth metabolism and the data for compact bone (femoral shaft) and for cancellous bone (vertebra). Although the agreement is not good in either type of bone, the data provide some support for the model for samples from those cases in which the average absorbed dose to the skeleton was less than 10^4 rad (100 Gy). There is some indication of an effect of radiation on the metabolism of radium in bone, but this conclusion is based on the assumption that the ICRP model provides a true description of the rate of loss of radium from the different types of bone.

39680 (ANL—78-65(Pt.2), pp 109-110) **^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases.** Holtzman, R.B.; Sha, J.Y.; Plondke, N.J. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

An eye from each of two radium patients (cases 01-144 and 01-017), who died about 50 yr after intake with terminal body burdens of 675 and 1160 nCi ^{226}Ra, respectively, was analyzed for ^{226}Ra, ^{210}Pb, ^{210}Po, and calcium. The total amounts in the eyes were 1.80 pCi ^{226}Ra, 1.3 pCi ^{210}Pb and 2.3 mg Ca for case 01-144, and 5.4 pCi ^{226}Ra, 2.1 pCi ^{210}Pb, 5.0 pCI ^{210}Po, and 14.2 mg Ca for case 01-017. The eye from the latter case was dissected and showed the highest concentrations (on a wet weight basis) of ^{226}Ra in the choroid and of ^{210}Po in the iris and choroid. The ^{226}Ra concentrations in the choroid, sclera, and iris of case 01-017 were appreciably greater than in soft tissues from this subject.

39681 (ANL—78-65(Pt.2), pp 111-117) **Field measurements of radium in the human body.** Toohey, R.E.; May, H.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Two whole body counting systems have been developed and employed for field measurements. The radium contents of nine previously unmeasured cases have been determined during three field trips. Future trips are being scheduled to make body radioactivity measurements on a specific subpopulation of CHR radium cases.

39682 (ANL—78-65(Pt.2), pp 138-141) **Plutonium injection cases: an update to 1977.** Rowland, R.E. (Univ. of California, Berkeley); Durbin, P.W. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Several hospitalized individuals of relatively short life expectancy were given intravenous injections of plutonium in 1945 to 1947, and excreta were collected and measured for as long as they remained hospitalized. Following the discovery by Durbin that some of these individuals were still living, she and, subsequently, the Center for Human Radiobiology at the Argonne National Laboratory made an effort to trace all of these unique cases. This search resulted in a published report which documented the doses of plutonium administered, the survival of the recipients, the causes of death, and the doses accumulated by liver and bone in each case. The calculated average organ doses accumulated by the members of this group to death or to 31 July 1977 are tabulated. The causes of death, contributory causes, and durations of illnesses, as determined from death certificates are also tabulated. As far as we can determine, the internally deposited plutonium was not responsible for or related to the death of any of these cases.

39683 (ANL—78-65(Pt.2), pp 154) **Ingestion of ^{241}Am sources intended for domestic smoke detectors: report of a case.** Rundo, J.; Fairman, W.D.; Essling, M.; Huff, D.R. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

A woman accidentally swallowed two sources of ^{241}Am of the type used in domestic smoke detectors; the nominal activity of each source was 2.5 μCi, and they were not voided until the 16th and 24th days after intake. A little less than 1% of the total activity of the two sources was found in the fecal material after removal of the sources and ^{241}Am was detected in the urine until the second source had been voided. The systemic burden was estimated to have been very much less than 1.5% of the activity released from the sources, and this was not significant from the point of view of radiological protection.

39684 (ANL—78-65(Pt.2), pp 155-162) **Measurements of ^{241}Am in vivo at long times after inhalation.** Toohey, R.E.; Essling, M.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The retention and distribution of ^{241}Am in the body of an industrial worker have been determined on several occasions extending over a period of ten years. The subject visited Argonne twice in 1967, and again in 1973, 1975, and 1977. For the period from September 1967 to December 1974, the subject underwent chelation therapy at another center. The therapy consisted of almost weekly injections of DTPA and excretion of over one-half of the initial body burden occurred during the period of therapy. Chelation therapy removed over one-half the initial body burden. No extensive redistribution of activity within the body occurred over the interval of no chelation therapy. Approximately one-third of the initial body burden remains in the skeleton and its distribution indicates deposition on bone surface. The slow decrease in skeletal burden may indicate that much of the original deposition has been buried by bone remodeling. Between 5 and 10% of the initial body burden remains in the lungs, including possible deposition in the thoracic lymph nodes. After the cessation of chelation therapy, there was a buildup of activity in the liver, probably translocated from the lungs and also from the skeleton during bone remodeling. This buildup may justify the resumption of chelation.

ANIMALS

REFER ALSO TO CITATION(S) 39667, 39692

39685 (ANL—78-65(Pt.2), pp 20-31) **Suppression of transformed foci, induced by alpha radiation of C3H 10T1/2 cells, by untransformed cells.** Lloyd, E.L.; Gemmell, M.A.; Henning, C.B. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The C3H 10T1/2 CL8 cell line obtained from a mouse embryo has been widely used for screening chemical carcinogens. Transformed foci are easily distinguishable in this system as crisscrossed, piled-up cells which stain more deeply than the surrounding untransformed cells. When these foci are ringcloned and subcultured, they have been shown to give rise to malignant tumors in C3H immunodepressed mice. Previous work showed that such malignant transformations, which occurred with a dose dependent frequency, could be induced by alpha particle irradiation. The present study, in turn, demonstrates that the expression of these transformations can be completely suppressed by co-cultivating the transformed cells with a large number of untransformed cells. The precise ratio of the number of untransformed cells to transformed cells to give complete suppression was found to vary in different experiments. Maximum effects were seen when a small number of transformed cells in low passage were used. These experiments may provide at least a partial explanation for the greatly increased frequency of transformations per cell irradiated in vitro, compared with the number of tumors observed after irradiation of the same number of cells in vivo. In addition, if conditions could be optimized whereby transformed foci could reproducibly be eliminated by the use of a known number of untransformed cells, this might have important applications in the prevention and treatment of certain human cancers.

39686 (ANL—78-65(Pt.2), pp 32-42) **Transformations of C3H 10T1/2 cells by Benzo(a)pyrene and subsequent attempts at suppression of transformed foci by untransformed cells and Vitamin A.** Lloyd, E.L.; Gemmell, M.A. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The mouse embryo cell line (C3H 10T1/2 CL8) has been shown here, in agreement with findings by others, to be transformed by benzo(a)pyrene (BP). Transformation studies were carried out at two different concentrations (0.25 μg BP/ml and 2.5 μg BP/ml) and two different cell densities (200 and 1000 cells/60 mm dish). Transformation frequencies per surviving cell were found to be greatest when the higher concentration of BP was used with the lower cell density. A comparison of these results with earlier alpha-irradiation experiments demonstrated the greater effectiveness of BP as a transforming agent in this cell system, although the foci produced by the two agents were morphologically similar. Attempts made to eliminate the expression of BP transformed foci by two different techniques were unsuccessful, although one of these had previously been shown to be effective with cells transformed by alpha particle irradiation. The two systems tested were treatment with retinyl acetate, a common nutritional form of Vitamin A and the previously successful technique - growth of transformed cells with large numbers of untransformed cells. The differences between the BP-induced transformations and those induced by alpha particle irradiation may result from intrinsic differences in the mechanism of action of the two carcinogenic agents, differences in the number of cell generations between the induction of the transformed foci and the subsequent treatment of the cells, or genetic differences between different foci.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 39578, 39579, 39670

39687 (ANL—78-65(Pt.2), pp 142-144) **Blood content and excretory plasma clearance of plutonium 10^4 days after injection.** Rundo, J.; Ilcewicz, F.H. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Blood samples were taken from two subjects who had been injected intravenously with about 0.3 μCi ^{239}Pu(IV) as the citrate 10^4 days previously; the subjects were on a metabolic ward, and all urine and feces were collected. Plutonium was determined by alpha-spectrometric isotope dilution in the samples of excreta and in separated plasma and red cells. The concentration of ^{239}Pu in the plasma of each subject was four or five times that in the red cells; the ^{239}Pu in the latter was thought to be due to entrained plasma. In dividing the daily excretion rate (urinary or urinary plus fecal) by

the contemporary concentration in the plasma, the urinary or total excretory plasma clearance was obtained. The results show that while the excretion rate is higher for the female than for the male, the reverse is true for the plasma clearance.

39688 (ANL—78-65(Pt.2), pp 145-153) **Distribution of injected plutonium in the skeleton and certain soft tissues.** Larsen, R.P.; Oldham, R.D.; Cacic, C.G.; Farnham, J.E.; Schneider, J.R. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The burden and macrodistribution of plutonium in the skeleton and its concentration in certain soft tissues have been determined in the remains of a woman who received plutonium by injection. The method of analysis was alpha spectrometric—isotopic dilution. The skeletal burden was 54 +- 2% of the amount injected. As expected, the concentrations in bones that are primarily trabecular were much higher than those that are primarily cortical; the ratio of the concentration in the bodies of the thoracic vertebrae to that in the diaphysis of the tibia was 40. The bones of the skull and the clavicle are quite representative of the entire skeleton. The concentrations in soft tissue are a factor of about 100 lower than those in bone. The concentration in hair increases markedly with the distance from the scalp.

39689 (ANL—78-65(Pt.2), pp 167-170) **Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se—selenomethionine.** Essling, M.A.; Toohey, R.E.; Huff, D.R. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

The retention and distribution of ^{75}Se in two Argonne employees who received intravenous injections of ^{75}Se—selenomethionine for diagnostic purposes have been followed for approximately three years post injection. The retention is consistent with Lathrop's equation, and the gross distribution of activity in the body does not change significantly with time.

39690 (ANL—78-65(Pt.2), pp 171-173) **Late excretion of ^{231}Pa and its decay products.** Holtzman, R.B.; Ilcewicz, F.H. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

Excretion rates of members of the naturally-occurring actinium series (4n + 3) were determined for a 69-year-old man who had acquired ^{231}Pa(T/sub 1/2/ = 32500 yr) about 45 years prior to this investigation. The body contents determined by whole body counting were approximately 71 nCi of ^{231}Pa, 51 nCi each of 22 yr ^{227}Ac and 18.2 day ^{227}Th, and 39 nCi of 11.4 day ^{223}Ra. All urinary and fecal samples were collected, as were representative daily diets during the 10 days the subject was maintained on a metabolic ward. The samples were wet ashed with nitric acid. After separation the ^{231}Pa and ^{227}Th were electrodeposited on stainless steel and alpha counted. The ^{223}Ra was coprecipitated with $BaSO_4$, mounted, and alpha counted. Actinium-227 was determined from the ^{227}Th daughter after a long growth period. The excretion rates varied quite dramatically over the 10-day study.

39691 (ANL—78-65(Pt.2), pp 174-175) **Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man.** Holtzman, R.B. 1978.

In Radiological and Environmental Research Division annual report, July 1977—June 1978.

A review of the literature and the results of some recent measurements were presented on the levels in man's diet of the naturally-occurring radionuclides ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po. The mean intakes for standard U.S. diets for these nuclides are tabulated. Intakes in other countries are similar to those in the U.S., but in localized populations the ^{226}Ra intake may be 8 or more pCi/day. The contents of ^{226}Ra in diets chosen by individuals ranged from 0.4 to 7 pCi/day. The few data on ^{228}Ra show intake of this nuclide to be about 80% that of ^{226}Ra, except in monazite areas where intakes of up to 160 pCi/day ^{228}Ra are reported, which may be 50 to 100 times that of ^{226}Ra. Drinking water contributes less than 5% of the daily intake, except in special areas.

ANIMALS

REFER ALSO TO CITATION(S) 39602, 39620

39692 (BNL—25910) **Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{2}H.** Slatkin, D.N.; Carsten, A.L.; Commerford, S.L.; Jones, K.W.; Kraner, H.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790325—6; IAEA-SM—237/57). Dep. NTIS, PC A02/MF A01.

From International symposium on biological implications of radionuclides released from nuclear industries; Vienna, Austria (26 Mar 1979).

Tritium can be incorporated biosynthetically from tritiated water into non-exchangeable C-^{3}H bonds of deoxyribonucleotides during DNA synthesis. Thus, accidental ingestion of tritiated water during pregnance may result in some degree of tritiation of DNA in primary oocytes of female progeny. The genetic hazard posed by such incorporation would depend mainly upon the amount of tritium incorporated into long-lived primary oocytes and upon the persistence of tritium in those cells. To study this problem in mammals while avoiding tritium-induced inhibition of oogenesis, it is proposed to measure deuterium that persists in the primary oocytes of mice after exposure to deuterated water in utero. Data from such measurements could be extrapolated to estimate the fraction of tritium that persists in human primary oocytes after incorporation from tritiated water during prenatal oogenesis. Preliminary studies are described which demonstrate the feasibility of these stable isotope tracer measurements.

PLANTS

REFER ALSO TO CITATION(S) 39605

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 38167

CELLS

REFER ALSO TO CITATION(S) 39686

PLANTS

REFER ALSO TO CITATION(S) 38593, 38594, 38595, 38596, 38597, 38598

39693 (PB—285440) **Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report.** Glass, N.R. (Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab.). Jun 1978. 62p. NTIS PC A04/MF A01.

This report is provided for the 'Health and Environmental Effects of Coal Utilization' Committee which was created by the request of the DOE in response to the President's Environmental Message. It evaluates ecological environmental effects of gaseous emissions and aerosols of various types which result from coal combustion. The report deals with NOx, SOx fine particulate, photochemical oxidant and acid precipitation as these pollutants affect natural and managed resources and ecosystems. The economic implications of ecological effects are identified within acceptable limits. In addition, the reliability of the data base upon which conclusions or estimates are made is evaluated to the degree possible. Aquatic and terrestrial effects are distinguished where the pollutants in question are clearly problems in both media. Sulfur oxide (SOx) emissions and nitrogen oxide (NOx) emissions are projected to be higher in 1985 and 2000 than in 1975. Since SOx and NOx are major contributors to acid precipitation, substantial increases in total acid deposition can be expected in the nation as a whole. At present, acid precipitation is most abundant in the North Central and Northeastern States. Estimates of the non health-related cost of air pollutants range from several hundred million dollars per year to $1.7 billion dollars per year. In general, these estimates include only those relatively easily measured considerations such as crop losses result-from acute pollution episodes or cost of frequent repainting as a result of air pollution.

39694 (DOE-tr—138) **Toxicological characteristics of shale waste waters.** Veldre, I.A. Translated from *Ryb. Khoz. Vnutr. Vodoyemov Latv. SSR;* 55-59(1963). 9p. Dep. NTIS, PC A02/MF A01.

The environmental and toxicological characteristics of shale industry waste water were investigated. The effluents tested included waste water from the tar distillation plant, designated water I, and a mixture of waste waters from the various steps in the phenol distillation plant, designated water II. Both waste waters were shown to exert a negative influence on the organoleptic properties (odor and color) of water bodies receiving the discharges. Water I at concentrations up to 0.4 ml/l and water II at concentrations up to 0.04 ml/l did not effect the BOC processes in receiving water bodies. Higher concentrations did appreciably effect the BOC processes. Ammonification and nitrification processes in water bodies were not effected by low concentrations of either waste water; higher concentrations delayed nitrite formation. Laboratory studies revealed that water II was 100 times more toxic to aquatic organisms (Daphnia, duckweed, and fish) than water I which was toxic at concentrations of 1 ml/l. Both waste waters at 1:1 dilution were absolutely lethal (100%) to white rats following a single administration to the gastrointestinal tract. The mucous membranes of rabbit eyes reacted strongly to the introduction of both waste waters into the conjunctival sac; and skin reactions were related to time of application when compresses containing both waste waters were applied to the shaved skin of rabbits. (ERB)

INVERTEBRATES

REFER ALSO TO CITATION(S) 39537, 39694

39695 (PB—286113) **Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report.** Bradley, B.P. (Maryland Univ., College Park (USA). Water Resources Research Center). Oct 1977. Contract DI-14-34-0001-7044. 20p. NTIS PC A02/MF A01.

The copepod species Eurytemora affinis and Acartia tonsa showed 50 to 60% mortality in cooling water with 0.5ppm Cl2 or BrCl (applied dosage) when entrained in the cooling system. However, after 5 min contact time, the biotoxicity was reduced to insignificant levels, hence mortalities in the mixing zone, given the applied dosage, would be negligible. There were no significant differences between residual biotoxicities of chlorinated and chlorobrominated cooling waters at either the low applied dose rates or at higher rates. The LC50 values were 362 + or - 26ppb and 403 + or - 46ppb at 24 hrs for bromine chloride and chlorine, respectively. Reproduction of Eurytemora was only affected at dosage rates well above those used in practice.

VERTEBRATES

REFER ALSO TO CITATION(S) 39537, 39613, 39617, 39618, 39669, 39693, 39694

MAN

REFER ALSO TO CITATION(S) 39564, 39566, 39567

39696 (COO—2874-46) **Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses.** Goldstein, I.F.; Cuzick, J. (Columbia Univ., New York (USA). School of Public Health; Columbia Univ., New York (USA). Dept. of Mathematical Statistics). Jun 1978. Contract EY-76-S-02-2874. 19p. Dep. NTIS, PC A02/MF A01.

A new methodology is proposed for the identification of environmental events of health significance. Health indices measured on a daily basis at various locations in a single geographical area are collected over time. First, the daily variations are examined to determine whether they reflect purely random variations or whether there are days on which there are extreme variations not plausibly explicable as random events. After such days are identified, the question of whether they occur only at a single location within the larger geographical area at one time, or whether they occur simultaneously at more than one location is investigated. Tests of statistical significance for both temporal and spatial clustering are proposed. The methodology is applied to daily hospital emergency room visits for various respiratory complaints to several New York City hospitals situated in two geographically separated districts which, however, have populations of similar socio-economic and ethnic composition.

39697 (PB—285130) **Zinc.** (National Research Council, Washington, DC (USA). Committee on Medical and Biologic Effects of Environmental Pollutants). May 1978. Contract EPA-68-02-1226. 742p. NTIS PC A99/MF A01.

This report summarizes the available information on zinc as it relates to its effects on man and his environment. Zinc is found in most soils, but some areas are deficient in it. Metallurgic operations contribute to zinc contamination in air, water and soil. Trace amounts of zinc are essential for normal growth in plants, animals and humans, however, excessive levels can bring on zinc toxicosis. Zinc deficiency is known to have caused congenital malformations in pregnant rats. Severe liver disease is commonly associated with loss of total body zinc. Zinc is not a highly toxic substance. Zinc toxicosis may occur only when very high dose levels overwhelm the homeostatic mechanisms controlling zinc uptake and excretion. Reports suggest humans may ingest 500 mg to 1 g or more daily without adverse effects. Ten or more g taken as a single oral dose may produce gastrointestinal distress, including nausea, vomiting and diarrhea. There are also suggestions in the literature that even higher dosage may produce dizziness and perhaps increase blood levels of pancreatic enzymes. Inhalation of zinc has been related to metal fume fever, an acute disability of short duration that can occur when fume is inhaled from metal heated to a temperature above its melting point. With repeated exposure, some degree of tolerance may be built up, but it will be lost when exposure to fume ceases for a period as short as two days. The pathogenesis of this disorder, including the role of zinc in it, is not understood.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

39698 (AD-A—057417) **Laser eye protection for flight personnel. Volume I. Phase report.** Chisum, G.T. (Naval Air Development Center, Warminster, PA (USA). Aircraft and Crew Systems Technology Directorate). 13 Jul 1978. 14p. NTIS PC A02/MF A01.

Developments in laser technology have resulted in an expanding use of lasers in many fields and laboratory situations. The implications of the use of lasers in military applications have been examined for flight personnel, and the requirement for eye protection determined. Recommendations for methods of providing that protection are made.

39699 (AD-A—058449) **Mechanisms of retinal damage from chronic laser radiation. Thresholds and mechanisms. Annual report, No. 4, 1 November 1976—31 October 1977.** Lawwill, T.; Crockett, S.; Currier, G. (Louisville Univ., KY (USA). Dept. of Ophthalmology). Aug 1977. Contract DAMD17-74-C-4026. 43p. NTIS PC A03/MF A01.

The effect upon the retina of exposure to large fields of bright visible light has been evaluated. The thresholds for permanent retinal damage for four hour exposures in rhesus monkeys have been established for white light, and laser lines of 514.5 nm, 488 nm, 457.9 nm, and 590 nm. The damage has been evaluated by ophthalmoscopy, electroretinography and light and electron microscopy. The shortest wavelength light (457.9 nm) is more effective in causing damage, particularly histological damage, which is spread throughout the fundus and throughout the retina layers. Functional damage shown by the electroretinogram follows a different action spectrum without the increased effect in the blue. There appears to be more than one mechanism for retinal damage in chronic light exposure, and at least one mechanism is not dependent solely upon the visual pigment and the pigment epithelium. Thresholds of permanent damage appear to be within one or two log units of light levels encountered in the normal visual environment. Newer data suggest that this damage is additive. Daily one hour exposures for four days produce damage equivalent to a single four hour exposure at the same retinal irradiance. (Author)

39700 (AD-A—059749) **Tests of biological integrity in dogs exposed to an electromagnetic pulse environment.** Baum, S.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Aug 1978. 12p. NTIS PC A02/MF A01.

Dogs were exposed to an electromagnetic pulse (EMP) environment 8 hours each day for 45 days. At the end of that time they had received 5.8 x 10 to the 6th power EMP at 5 pulses/sec with a peak electric field intensity of 447 kV/m. Biological tests were conducted to ascertain concentration of erythrocytes, leukocytes, neutrophils, lymphocytes, reticulocytes, and platelets. Bone marrow samples were obtained by biopsy from the ribs 7 days before and 7 days after the last EMP exposure for assessment of mitotic rubricytes and myelocytes. Pregnant female dogs were exposed to the EMP environment in order to study possible gross effects on fetuses. Reproductive capabilities of irradiated male animals were tested for 1 year after the last exposure. None of these tests revealed any injury in the EMP-irradiated dogs.

39701 (FDA—79-8080) **Measurements of electromagnetic fields in the close proximity of CB antennas.** Ruggera, P.S. (Bureau of Radiological Health, Rockville, MD (USA). Div. of Electronic Products). Jan 1979. 28p. GPO.

Citizen Band (CB) radios are in very wide use in the United States. In evaluating any possible radiation hazard associated with their normal use, the first step is to know the characteristics of the radiation typically emitted. The estimation of human exposure to the electromagnetic fields generated by these devices is complicated by the fact that exposure occurs in close proximity to the antenna or in the near field. Instrumentation and techniques which can be used to measure these fields, along with figures illustrating the resulting near-field distributions for the most popular types of antennas, are discussed in this report. The types of CB antennas for which data are presented with full legal power of 4 watts input, include 1/4-wavelength whip; base-, middle-, and top-loaded; two sets of twin antennas; and, a hand-held walkie-talkie. Comparisons are made between the field distributions for different antenna designs and different mounting locations. The measured emission levels at 5 cm from all of the antennas tested exceeded either 200 V/m or 0.5 A/m or both at some point along the vertical height of the antenna. Levels of this magnitude persisted for some of the antennas at 112 cm separation distance.

39702 (LBL—9085) **Changes in the electrocardiograms of rats and dogs exposed to dc magnetic fields.** Gaffey, C.T.; Tenforde, T.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

An evaluation of cardiovascular performance in magnetic fields (MF) is being undertaken. Cardiovascular performance is evaluated as a function of the MF strength. Since the vector characteristics of MF may be a factor influencing cardiovascular function, the positional arrangement of animals in a MF is being tested. In practice, each test animal is inserted between the poles of a magnet in a selected orientation that locates the heart in the center of the MF. The electrocardiogram (ECG) is recorded before, during, and following the application of a MF. The interval between summits of the R waves allows the average heart rate to be obtained. The average respiratory rate is measured from the baseline shifts in the ECG trace. The major change in the ECG pattern induced by a MF is an increase in the amplitude of the T wave of rats and dogs. In our rat study a 20,000 gauss field increased the T wave by about 450%; the dog's T wave was increased 750% by a 16,000 gauss field. These biomagnetic effects appear to be reversible. Out experiments with rats and dogs were designed to test for the presence of a magnetic strength threshold (MST) to evoke T wave enhancement. The MST is defined as the minimum number of gauss to product a measurable change with T wave amplitude. The MTS is 3.0 kgauss for rats and 0.9 kgauss for dogs. Augmentation of the T wave was found to be greatest when thelines of the MF were perpendicular to the long axis of the body and least when parallel. Hence, the orientation of the subject in the MF influences the ECG profile.

39703 (PB—285793) **Electromagnetic fields in biological media. I. Dosimetry-a primer on bioelectromagnetics. Final report.** Neuder, S.M. (Bureau of Radiological Health, Rockville, MD (USA)). Jul 1978. 32p. NTIS PC A03/MF A01.

Microwave and radiofrequency dosimetry, the determination of microwave and radiofrequency energy deposition in biological bodies, is discussed in terms of basic mathematical and physical considerations of electromagnetic interaction with biological systems. The electrical characteristics of the biological medium are mathematically related to the electromagnetic field properties. Variations of biological characteristics and internal field behavior as a function of exposure field frequency is discussed. Dosimetry aspects are stressed in terms of power absorption during field exposures.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 38130, 39256, 39662

39704 (SAND—79-0240) **Proposed standard for ES and H assurance programs.** Ellingson, A.C.; Trauth, C.A. Jr.; Tierney, M.S. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

An Environment, Safety and Health (ES and H) Assurance Program Standard is proposed: first, as a pattern for establishing such programs and second, as a yardstick for measurement of program performance. The proposed standard defines an ES and H Assurance Program which, in preliminary tests, appears cost-effective and yet allows for flexibility and creativity in the resolution of ES and H matters at the working level. Further tests of this standard are either underway or have been planned. The proposed standard is presented here for consideration and comments.

39705 (SAND—79-0796) **Quarterly report of progress for the periods: 1 October 1978—31 December 1978 and 1 January 1979—31 March 1979.** (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 62p. Dep. NTIS, PC A04/MF A01.

Progress is reported on efforts to generate hazards information through the Space Inventory and utilization System at the Department of Energy (DOE) headquarters. Data on facilities of 30,000 square feet or more are now computerized. Two desirable subroutines for environment, safety, and health (ES and H) information retrieval were identified and preliminary data analysis efforts were completed. A preliminary study that illustrates the various levels of activity for risk assessment that are possible and outlines some of the technical criteria that might be useful in determining the appropriate level of activity was completed. A draft standard for ES and H assurance programs was written. This standard is based on previous and current planning activities and efforts to test plans for feasibility, cost, and effectivity. The draft standard focuses on programmatic requirements in the ES and H area rather than detailed technical requirements. In the latter quarter of the six-month period major progress was made toward the development of a concensus ES and H Assurance Program Standard. The actual standard, developed in the preceding quarter, was reviewed, and a study of its characteristics was completed. A preliminary audit/appraisal program was designed, based on the ES and H Assurance Program Standard. This audit/appraisal program identifies those program elements to be audited, proposes types of evidence to be examined, data collection methods, and sampling plans, and presents both comprehensive, generic audit plans, and data rating guides. Significant progress toward the completion of guidelines for hazard identification, analyses, and management is being made. A large body of information was collected, analysis has begun, a general approach outlined, and arrangements for expert participation started.

GEOSCIENCES

39706 (UCRL—52681) **Earth Sciences Division, collected abstracts, 1978.** Taasevigen, D.K.; Henry, A.L.; Madsen, S.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1979. Contract W-7405-ENG-48. 70p. Dep. NTIS, PC A04/MF A01.

Abstracts of papers, internal reports, and talks presented during 1978 at national and international meetings by members of the Earth Sciences Division of the Lawrence Livermore Laboratory are compiled. The arrangement is alphabetical (by author). For any given report, a bibliographic reference appears under the name of each coauthor. A topical index at the end provides useful cross references, while indicating major areas of research interest in the Earth Sciences Division.

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 38087, 38275

39707 (DP-MS—79-11) **Determination of the location and connectivity of fractures in metamorphic rock with in-hole tracers.** Marine, I.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 16p. (CONF-790320—2). Dep. NTIS, PC A02/MF A01.

From Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks; Paris, France (19 Mar 1979).

A detailed investigation of the geohydrology of slightly fractured metamorphic rock by means of exploratory boreholes involves three steps: first, determining the exact location and character of the fractures penetrated by exploratory boreholes; second, determining the nature and connectivity of fractures between boreholes; third, determining the hydraulic parameters. This paper describes methods of determining the first of these, including core inspection, geophysical logs, packer tests, in-hole tracer tests, and dry drilling. Emphasis is given to the in-hole tracer tests by using an example from an investigation of slightly fractured metamorphic rock at the Savannah River Plant near Aiken, South Carolina, U.S.A. 7 figures, 2 tables.

39708 **Finite element method for subsurface hydrology using a mixed explicit-implicit scheme.** Narasimhan, T.N.; Neuman, S.P.; Witherspoon, P.A. (Univ of Calif, Lawrence Berkeley Lab). *Water Resour. Res.;* **14**: No. 5, 863-877(Oct 1978).

The mixed explicit-implicit Galerkin finite element method developed previously by the authors is shown to be suited for a wide class of problems arising in subsurface hydrology. These problems include confined saturated flow, unconfined flow under free surface conditions subject to the Dupuit assumption, flow in aquifers which are partly confined and partly unconfined, axisymmetric flow to a well with storage, and flow in saturated-unsaturated soils. Five examples are presented to demonstrate the versatility and power of this new approach. A purely physical derivation of the finite element equations which does not rely on the Galerkin formalism is also included.

GEOPHYSICS

39709 **Alternative methods for determining the electrical conductivity of core samples.** Lytle, R.J.; Duba, A.G.; Willows, J.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Rev. Sci. Instrum.;* **50**: No. 5, 611-615(May 1979).

Electrode configurations are described that can be used in measuring the electrical conductivity of a core sample and that do not require access to the core end faces. The use of these configurations eliminates the need for machining the core ends for placement of end electrodes. This is because the conductivity in the cases described is relatively insensitive to the length of the sample. We validated the measurement technique by comparing mathematical models with actual measurements that were made perpendicular and paralled to the core axis of granite samples.

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 39958

39710 (NUREG/CR—0450) **New Madrid seismotechtonic study: activities during fiscal year 1978.** Buschbach, T.C. (Illinois State Geological Survey, Urbana (USA)). Sep 1978. 138p. NTIS, PC A07/MF A01.

Gravity surveys were made in Kentucky and Indiana and tied to the national network. Preliminary Bouguer gravity maps were made. A 150 Kilometer seismic refraction line along the Wabash Valley Fault system was monitored. Geologic studies began in the Wabash River area and seven seismic stations were installed and began operating. Surface geologic mapping located faulting in Missouri Bootheel Tertiary Sediments. Middle Cambrian Western Kentucky Fossils found correlate with Conasuaga strata of Eastern U.S. and represent the oldest sedimentary rocks in the study area. A possible broad expanse of pre-late Cambrian fine clastic sediments is indicated in the Pascola Arch below the Cretaceous. Studies suggest that faulting is not continuous along the base of the Tiptonville scarp as previously indicated by trenching. Data have been provided to prepare preliminary maps that show rock types and Precambrian basement configuration. Separate abstracts were prepared for four sections of the annual report.

39711 (SLAC-TN—79-1) **Trip report: UCSB earthquake damage survey.** Johnson, E.K.; Winch, T.R. (Stanford Linear Accelerator Center, CA (USA)). Jan 1979. Contract EY-76-C-04-0515. 37p. Dep. NTIS, PC A03/MF A01.

The effects of the August 13, 1978, earthquake on the Santa Barbara campus of the University of California were studied by observation and interviews on September 25, 1978. Performance of the basic systems on the campus in response to the earthquake is reviewed. Comments regarding disaster planning, follow-up problems, support levels, etc., are presented. A copy of the emergency procedures of the Facilities Management Department is provided. (RWR)

39712 Use of combined geophysical studies for investigating the tectonics of the crystalline basement of western regions of the Russian platform. Stepanov, V.P.; Kenzin, F.A. *Razved. Geofiz.;* No. 72, 131-139(1976). (In Russian).

An interpretation was made of detailed and highly accurate data from gravity surveying, magnetosurveying and seismosurveying on the Novgorod (Priil'men'e) and Plungenskii sections of the border zone of the Valdaiskii downwarp and the near-Baltic depression. From the geophysical and deep drilling data, maps were composed of the surface of the crystalline basement. It is recommended that this technique be tested more widely on the Moscow syneclise (broad structural depression) in the search for Predevonian uplifts.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 39505, 39525

39713 Seismic surveys by reflected waves on the Russian platform. Berzon, I.S.; Gamburtsev, A.G.; Kondrat'ev, O.K.; Kuznetsov, V.V.; Starodubrovskaya, S.P. *Razved. Geofiz.;* No. 72, 3-10(1976). (In Russian).

This article presents the results of studies directed to raising the efficiency of seismic surveys by the method of reflected waves on the Russian platform. A presentation is given of the results of a theoretical and experimental investigation of the wave field, mainly, in the Saratovskii area along the Volga. Methods were developed for isolating useful waves on a background of disturbances. On the basis of the studies which were made, recommendations are presented on methods of experimental and theoretical study of the wave field, energy analysis of its structure, and multi-stage data treatment on a computer.

39714 (UCRL—52665) **Seismic monitoring: a unified system for research and verifications.** Thigpen, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1979. Contract W-7405-ENG-48. 44p. Dep. NTIS, PC A03/MF A01.

A system for characterizing either a seismic source or geologic media from observational data was developed. This resulted from an examination of the forward and inverse problems of seismology. The system integrates many seismic monitoring research efforts into a single computational capability. Its main advantage is that it unifies computational and research efforts in seismic monitoring. 173 references, 9 figures, 3 tables.

39715 Technique of grouping electrospark sources. Kalinin, A.V.; Kalinin, V.V.; Pivovarov, B.L. *Razved. Geofiz.;* No. 72, 40-50(1976). (In Russian).

The grouping of electrospark sources of elastic waves for use in seismic surveys is examined on the basis of a single main power line. A study is made of the factors having an effect on the intensity and form of excited oscillations when using emitters of this type. Formulas are presented for calculating the interelectrode distances at which the group of emitters can be considered as a group of autonomous sources. Estimates are made for power losses to the main line, and details of construction are recommended for multielectrode emitters.

39716 Calculating group explosion parameters with the purpose of increasing the seismic effect. Nazirov, N.Kh. *Razved. Geofiz.;* No. 72, 50-52(1976). (In Russian).

A description is given of the results of investigating the intensity of reflected waves as a function of the mass of the charge for flatland in the Crimea. It was established that as a first approximation the dependence can be expressed by a relation of the form: K = q P exp (m(P)). Here K is the amplitude of the reflected waves, and P is the mass of the charge. Here q is a proportionality coefficient, and m(P) is calculated from the formula: m(P) = 1g k/1g P. The individual charges for a group explosion should not exceed 10 kg for a given territory in order to obtain high efficiency. 2 figures, 1 table.

39717 Use of simultaneous grouping of sources and receivers of elastic oscillations in seismic surveys. Ganiev, V.A. *Razved. Geofiz.;* No. 72, 60-66(1976). (In Russian).

A look is taken at the possibility of replacing a group of sources and receivers of oscillations by an equivalent interference system having identical characteristics of directionality. By this means it is possible to simplify somewhat the practical selection of parameters in the grouping of sources and receivers, and also to establish a number of properties of equivalent groups, innate to groups having an inhomogeneous distribution of sensitivity.

39718 Unit for automatically constructing curves of the fall in intensity of seismic signals. Evseev, G.S.; Suikov, V.V. *Razved. Geofiz.;* No. 72, 72-76(1976). (In Russian).

A description is given of a device for registering decaying seismic oscillations caused by an explosion. The block diagram is described along with its inclusion in a field seismic station and in the equipment "Luch". A number of the test results are given.

39719 Separation of gravitational and magnetic anomalies for vertical cylindrical bodies. Antonov, Yu.V. *Razved. Geofiz.;* No. 72, 92-98(1976). (In Russian).

Results are presented on the use of a proposed method for separating potential fields according to the distribution of the functions g/sub x/ and g/sub z/ of horizontal and vertical components. The method is applicable for bodies having an infinite extent in the horizontal or vertical directions.

39720 Technique and results of interpreting gravimetric data for investigating the deep geological structure of the Russian plate. Kozlova, E.F.; Patrusheva, V.A. *Razved. Geofiz.;* No. 72, 105-112(1976). (In Russian).

A look is taken at the results of applying an analytic continuation to lower semispace for the vertical, normalized gravity gradient in order to investigate the depth structure of the Russian plate in the earth's crust. It appears that the method made it possible to make a judgement on the distribution of density inhomogeneities in the earth's crust. The depth structure of the region is characterized along seven profiles having an overall length of 4300 km.

39721 Role of gravitational field transformations in studying deep, density separation boundaries in the precaspian depression. Andreev, A.P.; Kolchina, G.I. *Razved. Geofi..;* No. 72, 113-119(1976). (In Russian).

In studying the depth structure of the earth's crust, use is frequently made of regional gravitational fields which are obtained by transforming the initial field by one or more methods: by averaging, by recalculating to a higher semispace, etc. Model studies showed that with the presence of a large number of intensive local anomalies of different signs in the initial field, the transformation of the gravitational field with the purpose of isolating the regional component does not solve the problem, since it is not possible to establish the effect from the deep density boundaries.

39722 Nature of local gravitational anomalies in northern Ustyurt. Matusevich, A.V.; Shraibman, V.I. *Razved. Geofiz.;* No. 72, 119-125(1976). (In Russian).

On the basis of analyzing numerous density determinations of sedimentary deposits in northern Ustyurt it was established that there is a regular increase in ore crust density with deposit depth in the absence of sharp jumps at the boundaries of separate layers. Local gravitational anomalies observed over anticlinal structures are explained by the effect of density changes of stratigraphic combinations, as shown in the literature. In this situation the correlation methods of interpreting gravity anomalies are the most effective.

39723 Use of data from deep seismic probing in the interpretation of gravimetric data. Kolchin, G.I.; Khrychev, B.A. *Razved. Geofiz.;* No. 72, 128-131(1976). (In Russian).

A look is taken at some results of deep seismic probing and calculations of gravity anomalies from separate elements along a cross-section of the earth's crust. It was established that the overall

gravitational effect from the Mohorovitch boundary and the density inhomogeneity of the lower part of the earth's crust, calculated from deep seismic probing data, can be accepted as being beyond the level of a "normal" field in interpreting anomalies associated with geological structures, which are detected on the surface or occur at low depths.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 38188, 38189

39724 (EPRI-NP—920) **Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report.** Anderson, D.G.; Espana, C. (Fugro, Inc., Long Beach, CA (USA)). Nov 1978. 140p. Dep. NTIS, PC A07/MF A01.

A review is presented of procedures which can be used for the determination in situ of dynamic soil properties at earthquake-compatible strain amplitudes as required for soil—structure interaction studies. The purpose of this review is to document test procedures and concepts and to present the advantages and limitations associated with these methods from both theoretical and practical standpoints. The study involves a review of published literature relevant to the topic and discussions with various individuals from academic, consulting, defense, and governmental organizations with expertise in the fields of wave propagation, testing in situ, and solid mechanics. 258 references, 94 figures, 16 tables.

39725 (LBL—7038) **Thermal properties of Gable Mountain basalt cores, Hanford Nuclear Reservation.** Martinez-Baez, L.F.; Amick, C.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1978. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

Thermal conductivities were measured, using a steady-state comparator apparatus, at a fixed stress and at two temperature levels. Specific heats were calculated as a function of temperature from oxide analyses. Bulk densities were measured at room conditions; densities at elevated temperatures were estimated from available thermal expansion data. From the above data, thermal diffusivities were calculated.

39726 (SAND—78-7076) **Structural petrology of undeformed and experimentally deformed halite samples from USERDA site No. 7 and No. 9.** Callender, J.; Ingwell, T. (New Mexico Univ., Albuquerque (USA)). 14 Jun 1977. Contract AC04-76DP00789. 162p. Dep. NTIS, PC A08/MF A01.

Preliminary data from USERDA test holes No. 7 and No. 9 in the Salado Formation of southeastern New Mexico are presented. Cores consist primarily of halite (> 80 modal percent), clay, polyhalite, anhydrite, celestite, iron oxide, and magnesite. Macroscopic features of undeformed core include moderately tight grain boundaries, large cavities (≦ 8 mm^2), fluid inclusions, rare intragranular dislocations, and coarse and bimodal textures. Petrographic examination reveals numerous secondary fluid inclusions of variable size, blebby halite and transected hopper crystals, all of which suggest mobility and recrystallization of the primary evaporite assemblages. Deformed core shows a complex group of fabric elements, including tight grain boundaries, intercrystalline lattice rotation, cavity deformation and closure, distortion of hopper crystals, polygonization, irregular lattice dislocations, glide dislocations, and climb dislocations. Grain boundaries become tight or locked with deformation, forming pinned and bulged grains. Intercrystalline lattice rotation causes grains to rotate as much as 17° to develop preferred orientation. Polygonization yields fabrics analogous to prophyroclasts in cataclastic rocks. Irregular dislocations are relatively abundant. Glide dislocations are also abundant in many deformed specimens. Individual mineral components within deformed halite also exhibit deformational fabrics. Folded layers of clay and anhydrite, and bent and broken single crystals of anhydrite are present in some samples. Secondary fluid inclusions apparently migrate in response to differential stress and form along dislocations in halite, healing the dislocations by secondary crystallization and forming discontinuous or completely healed dislocation fabrics. 67 figures, 9 tables.

39727 (SAND—79-0115) **Interim summary of Sandia creep experiments on rock salt from the WIPP study area, southeastern New Mexico.** Wawersik, W.R.; Hannum, D.W. (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract ACO4-76DP00789. 76p. Dep. NTIS, PC A05/MF A01.

Triaxial creep experiments on rock salt were carried out in support of the proposed Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. Results include digital data in condensed data files and numerous graphical comparisons for rock salt from two horizons 2000 to 2100 ft and 2600 to 2800 ft (625 to 650 m; 810 to 875 m) as a function of principal stress difference, temperature and confining pressure. Qualitative examinations showed that the rock salt exhibited all known stages of creep, i.e., primary, secondary and tertiary creep followed by creep fracture. Preliminary evaluations of axial strain time records during primary creep (ϵ_1, t) are discussed assuming the applicability of so-called power law creep but without implying that the conventional power relationship is a constitutive equation. The primary creep data of this study appear to be independent of pressure within fairly wide experimental scatter. Estimates of steady state creep rates of interest to the WIPP vary from $\dot{\epsilon}_1 < 10^{-10}\ s^{-1}$ to approximately $10^{-8}\ s^{-1}$. Tertiary creep and creep fracture were observed at ambient temperature and at 100°C. Creep fracture was not observed in a limited number of experiments at 200°C and is deemed unlikely except, possibly, at very low confining pressure, $\sigma_3 \leqq 100$ psi (0.7 MPa). To predict creep fracture, the use of an empirical procedure was suggested which correlates permanent time-dependent strains (damage) with limiting damage which is established from complete quasi-static stress-strain curves including pre- and post-failure records. 19 figures.

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 39611

39728 (PB—286346) **Marine-related research at MIT, 1978: including projects on marine-resources, ocean utilization and coastal zone management.** Passero, B. (Massachusetts Inst. of Tech., Cambridge (USA). Sea Grant Program). Jun 1978. 78p. NTIS PC A05/MF A01.

In keeping with Sea Grant's role as a focal point for the Institute's marine-related research, each year Sea Grant issues this Directory of Marine-Related Research at MIT. This report lists current research projects by broad subject areas and includes a subject index.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 39919

39729 (N—78-29031) **The charge and energy spectra of heavy cosmic ray nuclei.** Scarlett, W.R.; Freier, P.S.; Waddington, J.C. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Jul 1978. Contract NGR-25-005-050. 25p. NTIS PC A02/MF A01.

A charged particle detector array flown in a high-altitude balloon detected and measured some 30,000 cosmic ray nuclei with Z greater than or equal to 12. The charge spectrum at the top of the atmosphere for nuclei with E greater than 650 MeV/n and the energy spectrum for 650 less than or equal to E less than 1800 MeV/n are reported and compared with previously published results. The charge spectrum at the source of cosmic rays is deduced from these data and compared with a recent compilation of galactic abundances.

39730 (N—78-31040) **Diffuse fluxes of cosmic high energy neutrinos.** Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 30p. NTIS PC A03/MF A01.

Production spectra of high-energy neutrinos from galactic cosmic ray interactions with interstellar gas and extragalactic ultra-high energy cosmic-ray interactions with microwave black-body photons are presented and discussed. These production processes involve the decay of charged pions and are thus related to the production of cosmic gamma-rays from the decay of neutral pions. Estimates of the neutrino fluxes from various diffuse cosmic sources are then made and the reasons for significant differences with previous estimates are discussed. Predicted event rates for a DUMAND type detection system are significantly lower than early estimates indicated.

STARS

REFER ALSO TO CITATION(S) 39930

39731 (LA-UR—78-3089) **Variable star research at Los Alamos.** Davis, C.G.; Cox, A.N.; Adams, T.F. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 12p. (CONF-781175—1). Dep. NTIS, PC A02/MF A01.

From 46. International Astronomical Union colloquium on Changing trends in variable star research; Hamilton, New Zealand (27 Nov 1978).

Three major areas of variable star research at Los Alamos are carried out: (1) a study using improved Cepheid light curves in order to define more precisely the Hertzsprung sequence, in collaboration with John Castor and John Cox; (2) the suggestion by A. Cox that helium enrichment occurs in the stellar envelope, by a stellar wind, which may explain many of the mass anomalies, this work being with G. Michaud, D. King, R. Deupree, and S. Hodson; and (3) the study of Cepheid and RR Lyrae colors to compare directly to the observations. A brief discussion of the present status of each of these research programs will be given. 25 references.

39732 (N—78-28024) **Observations of the 51.8 micron (O III) emission line in Orion.** Melnick, G.; Gull, G.E.; Harwit, M.; Ward, D.B. (Cornell Univ., Ithaca, NY (USA). Center for Radiophysics and Space Research). 1978. Contract NGR-33-010-146. 16p. NTIS PC A02/MF A01.

The 51.8 micron fine structure transition $P^2{}_3P^2{}_3P^1$ for doubly ionized oxygen was observed in the Orion nebula. The observed line strength of 5 +- 3 x 10 $^{-15}$ watt/cm^2 is in good agreement with theoretical predictions. Observations are consistent with the newly predicted 51.8 micron line position. The line lies close to an atmospheric water vapor feature at 51.7 micron, but is sufficiently distant so that corrections for this feature are straightforward. Observations of the 51.8 (O III) line are particularly important since the previously discovered 88 micron line from the same ion also is strong. This pair of lines should, therefore, yield new data about densities in observed H II regions; or else, if density data already are available from radio or other observations, the lines can be used to determine the differential dust absorption between 52 and 88 micron in front of heavily obscured regions.

39733 (N—78-28025) **Far infrared polarization of the Kleinmann—Low nebula in orion.** Gull, G.E.; Houck, J.R.; Mccarthy, J.F.; Forrest, W.J.; Harwit, M. (Cornell Univ., Ithaca, NY (USA)). 1978. Contract NGR-33-010-146. 20p. NTIS PC A02/MF A01.

Elongated dust grains aligned by local magnetic fields are thought to absorb background radiation and produce linear and circular polarization which exhibit strong wavelength dependence in the near infrared. The NASA Kuiper observatory 91 cm infrared telescope was used to observe polarization characteristics of the Kleinmann-Low nebula in four far infrared wavelength bands in order to detect emission from these same oriented grains at longer wavelengths, and determine whether this radiation shows a direction of polarization perpendicular to that seen in the near infrared. The polarization, if any, that characterized the radiation in the three longest wavelength filter positions (28-48 micron, 44-72 micron, and 70-115 micron) is small. The noisiest measurements were obtained in the 16-33 micron filter position. Possible explanations for the low polarization observed at long wavelengths are explored.

39734 (N—78-31017) **The potential for astrometry in the infrared.** Storey, J.W.V. (California Univ., Berkeley (USA). Dept. of Physics). 1978. Contracts NGL-05-003-272;NSF AST-77-12256. 11p. NTIS PC A02/MF A01.

Infrared interferometry promises to be a useful astrometric technique. Preliminary measurements of the star alpha Orionis made with a heterodyne interferometer exhibit phase coherence over a period of at least 1000 seconds. The measurements were equivalent to a positional determination of 60 milliarcsecond accuracy every 5 seconds of integration.

39735 (N—78-31018) **An investigation of the far ultraviolet spectra of the pole-on Be stare mu Cen and upsilon Cyg. Final technical report.** Peters, G.J. (California Univ., Los Angeles (USA). Dept. of Astronomy). 30 Sep 1977. 97p. NTIS PC A05/MF A01.

The technique of spectrum analysis was used to interpret Copernicus U2 spectra (0.2 A resolution) and Lick Observatory coude spectra of the pole-on stars upsilon Cyg and Mu Cen. Features analyzed include C II lambda lambda II76 and 1247 A, N 11 lambda lambda 1085 and 3995 A, Si IV lambda lambda 1265 and 1309 A, Si lambda lambda 1110, 1297, and 4568 A, and Si IV lambda 1128 A. An initial set of physical parameters is obtained from ground-based spectra for the selected UV features. In general, there is no difficulty in fitting the observed features with profiles computed from the same model atmosphere, abundances, and vsin i which are suggested by the visual spectral features. The analysis suggests an effective temperature of 24,000 K and a log g of 3.8 for upsilon Cyg. T/sub eff/ and log g adopted for mu Cen are 20,500 K and 3.7, respectively. Upsilon Cyg appears to have a low abundance of carbon, but normal abundance of nitrogen and silicon. The abundances of nitrogen and silicon in mu Cen are normal; carbon results are inconclusive.

39736 (UCRL—82057(Rev.1)) **Evolution and explosion of massive stars.** Weaver, T.A.; Woosley, S.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1978. Contract W-7405-ENG-48. 43p. (CONF-781245—2). Dep. NTIS, PC A03/MF A01.

From 13. Texas conference on relativistic astrophysics; Munich, F.R. Germany (14 Dec 1978).

An attempt is reported to build self-consistent evolutionary models of complete massive stars, starting from their observable zero-age main sequence configurations, and evolving through their various hydrostatic nuclear burning stages, iron core collapse, bounce, outward-going shock formation, and finally, explosive nucleosynthesis and supernovae light curve formation. The model incorporates implicit hydrodynamics with a new treatment of time-dependent convection and semiconvection, and a careful treatment of the complexities of the advanced stages of stellar burning. The model was used to completely evolve population I stars of 15 and 25 M/sub solar mass/, with excellent agreement with the known properties and the prediction of other properties. 65 references. (JFP)

39737 **Matter-antimatter accounting, thermodynamics, and black-hole radiation.** Toussaint, D.; Treiman, S.B.; Wilczek, F.; Zee, A. (Princeton University, Princeton, New Jersey 08540). *Phys. Rev., D;* 19: No. 4, 1036-1045(15 Feb 1979).

We discuss several issues bearing on the observed asymmetry between matter and antimatter in the content of the universe, in particular, the possible role in this of Hawking radiation from black holes, with allowance for weak C- and T-violating interactions. We show that the radiation, species by species, can be asymmetric between baryons and antibaryons. However, if baryon number is microscopically conserved there cannot be a net flux of baryon number in the radiation. Black-hole absorption from a medium with net baryon number zero can drive the medium to an asymmetric state. On the other hand, if baryon conservation is violated, a net asymmetry can develop. This can arise through asymmetric gravitational interactions of the radiated particles, and conceivably, by radiation of long-lived particles which decay asymmetrically. In the absence of microscopic baryon conservation, asymmetries can also arise from collision processes generally,say in the early stages of the universe as a whole. However, no asymmetries can develop (indeed any "initial" ones are erased) insofar as the baryon-violating interactions are in thermal equilibrium, as they might well be in the dense, high-temperature stages of the very early universe. Thus particle collisions can generate asymmetries only when nonequilibrium effects driven by cosmological expansion come into play. A scenario for baryon-number generation suggested by superunified theories is discussed in some detail. Black-hole radiation is another highly nonequilibrium process which is very efficient in producing asymmetry, given microscopic C, T, and baryon-number violation.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

39738 (LA-UR—79-309) **Ion acceleration at the earth's bow shock: a review of observations in the upstream region.** Gosling, J.T.; Asbridge, J.R.; Bame, S.J.; Feldman, W.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 21p. (CONF-790144—1). Dep. NTIS, PC A02/MF A01.

From Workshop on particle accleration mechanisms in astrophysics; La Jolla, CA, USA (3 Jan 1979).

Positive ions are accelerated at or near the earth's bow shock and propagate into the upstream region. Two distinctly different populations of these ions, distinguished by their greatly different spectral and angular widths, can be identified there. The type of ion population observed in the upstream region is strongly correlated with the presence or absence of long-period compressive waves in the solar wind. Very few ions are accelerated in the vicinity of the shock to energies much above about 100 keV. It is not yet clear whether the most energetic ions (i.e., those near 100 keV) are accelerated at the shock or in broad disturbed region upstream from the shock. In either case stochastic acceleration by turbulent electrostatic fields seems to be the most viable candidate for the acceleration of the most energetic particles.

39739 (N—78-31021) **X-ray observations of a flare in NGC4151 from OSO-8.** Mushotzky, R.F.; Holdt, S.S.; Serlemitsos, P.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1978. 17p. NTIS PC A02/MF A01.

The 2-60 keV flux from NGC4151 changed by a factor of two on a timescale of 1.5 days. No fluctuations were detected in excess of a factor of three on timescales less than four hours. During a total observation of approximately 11 days there were no statistically significant changes in spectral shape. The spectrum was fitted by a power law with photon index alpha approximately 1.42 + or - 0.06 and column density N/sub H/ approximately 7.5 + or - 0.5 x 10 to the 22d power at/cu cm. A 2 sigma residual to this fit implies fluorescent Fe line emission with E. W. approximately 240 eV. Both synchrotron self-Compton and thermal Compton models are consistent with the X-ray data.

39740 (N—78-31038) **Discovery of iron line emission in the Hercules X-1 low-state spectrum with HEAO-1.** Pravdo, S.H.; Boldt, E.A.; Holt, S.S.; Rothschild, R.E.; Serlemitsos, P.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 17p. NTIS PC A02/MF A01.

The line energy, equivalent width, binary phase dependence, and intrinsic width of the iron line emission feature observed in the low-state spectrum of Hercules X-1 are examined. Deductions are made concerning secondary X-ray emission from this binary system.

39741 (N—78-32016) **X-ray observations of BL Lac objects.** Mushotzky, R.F.; Boldt, E.A.; Holt, S.A.; Pravdo, S.H.; Serlemitsos, P.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1978. 13p. NTIS PC A02/MF A01.

The BL Lac objects MK501 and MK421 were observed with OSO-8 and HEAO-1 X-ray detectors in the 2-60 keV band. Their spectra are similar with best fitting power laws having energy index -.4 alpha 4. A soft X-ray excess is indicated in their spectra. There was no detectable X-ray absorption with implied column densities N/sub H/ = 1.5 x 10^{22} MK421 was a factor 6 weaker in November 1977 than in May 1977. An identification of PKS0548-322 with a new source H0548,-32 is suggested.

39742 (N—78-32017) **High energy x-ray spectra of Cygnus XR-1 observed from OSO-8.** Dolan, J.F.; Crannell, C.J.; Dennis, B.R.; Frost, K.J.; Orwig, L.E. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1978. 26p. NTIS PC A03/MF A01.

X-ray spectra of Cygnus XR-1 were measured with the scintillation spectrometer on board the OSO-8 satellite during a period of one and one-half to three weeks in each of the years from 1975 to 1977. Observations were made when the source was both in a high state and in a low state. Typical spectra of the source between 15 and 250 keV are presented. The observed pivoting effect is consistent with two temperature accretion disk models of the X-ray emitting region. No significant break in the spectrum occurred at energies up to 150 keV. The high state as defined in the 3 to 6 keV bandwidth was found to be the higher luminosity state of the X-ray source. One transition from a low to a high state occurred during observations. The time of occurrence of this and other transitions is consistent with the hypothesis that all intensity transitions occur near periastron of the binary system, and that such transitions are caused by changes in the mass transfer rate between the primary and the accretion disk around the secondary.

SOLAR PHENOMENA

39743 (AD-A—058325) **The primary energy release in reconnection flare models. Interim report.** Spicer, D.S. (Naval Research Lab., Washington, DC (USA)). Apr 1978. 18p. NTIS PC A02/MF A01.

A brief review is given on the primary energy release associated with reconnection flare models. In particular will be examined how the most recent flare models of Spicer and Uchida and Sakurai have attempted to overcome the standard difficulties with reconnection, i.e., the rate of reconnection and subsequent energy release. In addition comments are made on whether the primary flare instability is explosive or non-explosive.

39744 (N—78-28031) **A three-dimensional model of corotating streams in the solar wind. 1: theoretical foundations.** Pizzo, V.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1978. 54p. NTIS PC A04/MF A01.

The theoretical and mathematical background pertinent to the study of steady, corotating solar wind structure in all three spatial dimensions (3-D) is discussed. The dynamical evolution of the plasma in interplanetary space (defined as the region beyond roughly 35 solar radii, where the flow is supersonic) is approximately described by the nonlinear, single fluid, polytropic (magneto-) hydrodynamic equations. Efficient numerical techniques for solving this complex system of coupled, hyperbolic partial differential equations are outlined. The formulation is inviscid and nonmagnetic, but methods allow for the potential inclusion of both features with only modest modifications. One simple, highly idealized, hydrodynamic model stream is examined to illustrate the fundamental processes involved in the 3-D dynamics of stream evolution. Spatial variations in the rotational stream interaction mechanism were found to produce small nonradial flows on a global scale that lead to the transport of mass, energy, and momentum away from regions of relative compression and into regions of relative rarefaction.

39745 (N—78-29027) **A study of large-scale solar magnetic and velocity fields.** Duvall, T.L. Jr. (Stanford Univ., CA (USA). Inst. for Plasma Research). Dec 1977. Contracts NGR-05-020-559;N00014-75-C-0207. 122p. NTIS PC A06/MF A01.

Magnetograms are used to derive the average poloidal and toroidal components of the photospheric magnetic field near solar minimum. The poloidal field near the poles is found to have the dipolar structure characteristic of solar minimum with a positive field in the north and negative field in the south, both with a measured strength of approximately 1 gauss. At lower latitudes the poloidal field has the same polarity as the pole in that hemisphere, but the field strength has the reduced magnitude of approximately 0.1 gauss. A toroidal field of broad latitude extent is found to have opposite sense in the two solar hemispheres and a magnitude of approximately 0.1 gauss. The sense of the toroidal field is the same as that of the assumed subsurface toroidal field giving rise to active regions of solare cycle 21. The toroidal field is used to derive the electric current crossing the photosphere in conjunction with the magnetogram observations, an accurate determination of the relative wavelength shift of the spectral line is made for each position on the solar disk. The solar rotation, the limb effect on the disk and the possibility of a mean meridional circulation in the photosphere are studied.

39746 (N—78-29028) **A physical mechanism for the prediction of the sunspot number during solar cycle 21.** Schatten, K.H.; Scherrer, P.H.; Svalgaard, L.; Wilcox, J.M. (Stanford Univ., CA (USA). Inst. for Plasma Research). Feb 1978. Contracts NGR-05-020-559;N00014-76-C-0207. 13p. NTIS PC A02/MF A01.

On physical grounds it is suggested that the sun's polar field strength near a solar minimum is closely related to the following cycle's solar activity. Four methods of estimating the sun's polar magnetic field strength near solar minimum are employed to provide an estimate of cycle 21's yearly mean sunspot number at solar maximum of 140 plus or minus 20. This estimate is considered to be a first-order attempt to predict the cycle's activity using one parameter of physical importance.

39747 (N—78-29029) **The strength of the sun's polar fields.** Svalgaard, L.; Duvall, T.L. Jr; Scherrer, P.H. (Stanford Univ., CA (USA). Inst. for Plasma Research). Jan 1978. Contracts NGR-05-020-559;N00014-76-C-0207. 22p. NTIS PC A02/MF A01.

Observations at Stanford Solar Observatory of solar magnetic fields in the FeI line lambda 525.02 nm shows that a radial magnetic field measured at a point where the radius makes an angle rho with the line of sight is observed to be decreased by a factor cos rho. For field elements of 150 mT, magnetograph saturation causes the measured field to be too low by a factor of 1.8. The average field magnitude poleward of 55 deg latitude is measured to be near 100 μT. Variation of the apparent field over a 3 arc min aperture grazing the limb at central meridian amounts to a factor of two over the year; the field being strongest when the pole is tipped the most (7 1/4 deg) towards the observer. Combination of all the above results leads to the following picture of the magnetic field within the polar caps. The field is nearly radial, varying as B/sub p/ cos ^{8} theta where the field strength B/sub p/ at the pole (theta = 0 deg) is 1.15 mT, and falling off to below 0.2 mT at the polar cap boundary (theta = 35 deg). Within coronal holes outside of the polar cap the magnetic field strength at sunspot minimum is rather small (0.15 mT).

39748 (N—78-31030) **Pioneer 10 observation of the solar wind proton temperature heliocentric gradient.** Mihalov, J.D.; Wolfe, J.H. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Aug 1978. 15p. NTIS PC A02/MF A01.

Solar wind isotropic proton temperatures as measured out to 12.2 AU heliocentric distance by the Ames plasma analyzer aboard Pioneer 10 are presented as consecutive averages over three Carrington solar rotations and discussed. The weighted least-squares fit of average temperature to heliocentric radial distance, R, yields the power law R/sup -.52/. These average proton temperatures are not correlated as well with Pioneer 10's heliocentric radial distance (-.85) as are the corresponding average Zurich sunspot numbers R/sub Z/ (-.95). Consequently, it is difficult to isolate the spatial gradient in the Pioneer 10 solar wind proton temperatures by use of those data alone.

39749 (N—78-31031) **Reverse current in solar flares.** Knight, J.W. III. (Stanford Univ., CA (USA). Inst. for Plasma Research). Aug 1978. Contracts NGL-05-020-272;N00014-75-C-0673. 139p. NTIS PC A07/MF A01.

An idealized steady state model of a stream of energetic electrons neutralized by a reverse current in the pre-flare solar plasma was developed. These calculations indicate that, in some cases, a significant fraction of the beam energy may be dissipated by the reverse current. Joule heating by the reverse current is a more effective mechanism for heating the plasma than collisional losses from the energetic electrons because the Ohmic losses are caused by thermal electrons in the reverse current which have much shorter mean free paths than the energetic electrons. The heating due to reverse currents is calculated for two injected energetic electron fluxes. For the smaller injected flux, the temperature of the coronal plasma is raised by about a factor of two. The larger flux causes the

reverse current drift velocity to exceed the critical velocity for the onset of ion cyclotron turbulence; anomalous resistivity and an order-of-magnitude increase in the temperature result. The heating is so rapid that the lack of ionization equilibrium may produce a soft X-ray and EUV pulse from the corona.

39750 (N—78-31033) **A theory of local and global processes which affect solar wind electrons. 1: The origin of typical 1 AU velocity distribution functions: steady-state theory.** Scudder, J.D. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1978. 55p. NTIS PC A04/MF A01.

A detailed first-principle kinetic theory for electrons which is neither a classical fluid treatment nor an exospheric calculation is presented. This theory illustrates the global and local properties of the solar wind expansion that shape the observed features of the electron distribution function, such as its bifurcation, its skewness and the differential temperatures of the thermal and suprathermal subpopulations. Coulomb collisions are substantial mediators of the interplanetary electron velocity distribution function, and they place a zone for a bifurcation of the electron distribution function deep in the corona. The local cause and effect precept which permeates the physics of denser media is modified for electrons in the solar wind. The local form of transport laws and equations of state which apply to collision-dominated plasmas are replaced with global relations that explicitly depend on the relative position of the observer to the boundaries of the system.

39751 (N—78-32031) **Solar gamma rays above 8 MeV.** Crannell, C.J.; Crannell, H.; Ramaty, R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1978. 41p. NTIS PCA03/MF A01.

Processes which lead to the production of gamma rays with energy greater than 8 MeV in solar flares are reviewed and evaluated. Excited states produced by inelastic scattering, charge exchange, and spallation reactions in the abundant nuclear species are considered in order to identify nuclear lines which may contribute to the Gamma ray spectrum of solar flares. The flux of 15.11 MeV Gamma rays relative to the flux of 4.44 MeV Gamma rays from the de-excitation of the corresponding states in C_{12} is calculated for a number of assumed distributions of exciting particles. This flux ratio is a sensitive diagnostic of accererated particle spectra. Other high-energy nuclear levels are not so isolated as the 15.11 MeV state and are not expected to be so strong. The spectrum of Gamma rays from the decay of Pi dey is sensitive to the energy distribution of particles accelerated to energies greater than 100 MeV.

39752 (PB—285773) **Solar—geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Jun 1978. 173p.

This prompt report provides data for May 1978 on: alert period, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, coronal holes, inferred IP Magnetic field polarities, mean solar magnetic field, solar wind measurements, geomagnetic substorms, magnetograms of geomagnetic storm 30 April - 4 May, and energetic solar particles. It also provides data for April 1978 on: daily solar activity center, sudden ionospheric disturbances, solar x-ray radiation, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation. (Portions of this document are not fully legible)

39753 (PB—285774) **Solar—geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Jun 1978. 87p.

This comprehensive report for December 1977, November 1977 and Miscellaneous data provides data on active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, regional flare index, geomagnetic indices, cosmic rays, and GMS/SEM data for September 1977 event. (Portions of this document are not fully legible)

GALAXIES

REFER ALSO TO CITATION(S) 39739

39754 **Neutron beams in active galactic nuclei.** Eichler, D.; Wiita, P.J. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). *Nature (London);* **274**: No. 5666, 38-39(6 Jul 1978).

39755 **Model of the formation of elliptical galaxies.** Brown, W.K. (Los Alamos Scientific Lab., N.Mex. (USA)). *Astrophys. Space Sci.;* **54**: No. 2, 365-378(Apr 1978).

An analytical model of elliptical galaxy formation is formulated that yields predicted mass distributions. A good fit is obtained when the model is tested against the luminosity profile of NGC 3379. The present theory is identical to a parallel theory of solar system formation which suggests that the mass distribution of the solar system should be similar to that of NGC 3379. Comparison supports this conjecture.

COSMOLOGY

REFER ALSO TO CITATION(S) 39737

PLANETARY PHENOMENA

39756 (N—78-28027) **A bibliography of planetary geology principal investigators and their associates, 1976—1978.** (National Aeronautics and Space Administration, Washington, DC (USA)). May 1978. 105p. NTIS PC A06.

This bibliography cites publications submitted by 484 principal investigators and their associates who were supported through NASA's Office of Space Sciences Planetary Geology Program. Subject classifications include solar system formation, comets, and asteroids; planetary satellites, planetary interiors, geological and geochemical constraints on planetary evolution; impact crater studies, volcanism, eolian studies, fluvian studies, Mars geological mapping; Mercury geological mapping; planetary cartography; and instrument development and techniques. An author/editor index is provided.

39757 (N—78-30758) **Direct measurements of the polarization of terrestrial kilometric radiation from Voyagers 1 and 2.** Kaiser, M.L.; Alexander, J.K.; Riddle, A.C.; Pearce, J.B.; Warwick, J.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 16p. NTIS PC A02/MF A01.

Terrestrial radiation measurements obtained with planetary radio astronomy experiments on Voyager-1 and -2 during the early portions of each flight show the signals to be predominantly left-hand circularly polarized. Since these emissions were most probably generated above the Northern Hemisphere auroral zone, it is concluded that the radiation is emitted primarily in the extraordinary mode.

39758 (N—78-31027) **An emission mechanism for the Io-independent Jovian decameter radiation.** Goldstein, M.L.; Eviatar, A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1978. 46p. NTIS PC A03/MF A01.

A theory of the Io-independent decameter radiation is developed. The radiation results from excitation of the electromagnetic loss-cone instability by keV electrons, stably trapped near $L = 6$. The radiation is excited in Band 3 of the extraordinary mode. When the effects of refraction are estimated, it is shown that above 10 MHz radiation is beamed into the equatorial plane in a wide, but thin, conical sheet (Psi approximately equals 80 degrees). When the instability analysis is coupled with one of the octupole models of the Jovian magnetic field, the maximum convective growth of the instability occurs in the directions of the non-Io A, B, and C sources. The shape of the peak radio flux frequency spectrum is found to be a consequence of the loss cone shape of the electron distribution function.

39759 (N—78-31028) **Discrepancy in proton flux extrapolation along field lines in the middle Jovian magnetosphere.** Schardt, A.W.; Birmingham, T.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1978. 39p. NTIS PC A03/MF A01.

Fluxes of energetic electrons and protons in Jupiter's outer magnetosphere were observed to be modulated with the 10 hour rotation period of the planet. This modulation was due to the concentration of particles at the magnetic equator: the non-alignment of Jupiter's spin and rotation axes caused Pioneer-10 to oscillate between +20 deg and -19 deg magnetic latitude and, hence, between regions of stronger and weaker fluxes. The relationship between electron and proton fluxes observed off the magnetic equator was countered with measurements at the equatorial crossing radii of the same flux tubes by applying Liouville's theorem with the assumption that particles move so as to conserve their magnetic moments. A magnetic model which matches the intensity and direction of the magnetic field along the Pioneer 10 trajectory was used for determining the positions of the equatorial crossings. Energetic electrons compared in this way appear to be consistently described. Protons, on the other hand, show much weaker fluxes at the off-equatorial points than would be predicted by this simple application of Liouville's theorem.

39760 (N—78-32029) **Crustal evolution inferred from apollo magnetic measurements.** Dyal, P.; Daily, W.D.; Vanyan, L.L. (National

Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Sep 1978. 31p. NTIS PC A03/MF A01.

Magnetic field and solar wind plasma density measurements were analyzed to determine the scale size characteristics of remanent fields at the Apollo 12, 15, and 16 landing sites. Theoretical model calculations of the field-plasma interaction, involving diffusion of the remanent field into the solar plasma, were compared to the data. The information provided by all these experiments shows that remanent fields over most of the lunar surface are characterized by spatial variations as small as a few kilometers. Large regions (50 to 100 km) of the lunar crust were probably uniformly magnetized during early crustal evolution. Bombardment and subsequent gardening of the upper layers of these magnetized regions left randomly oriented, smaller scale (5 to 10 km) magnetic sources close to the surface. The larger scale size fields of magnitude approximately 0.1 gammas are measured by the orbiting subsatellite experiments and the small scale sized remanent fields of magnitude approximately 100 gammas are measured by the surface experiments.

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 39757

39761 (AD-A—058246) **High frequency drift waves with wavelengths below the ion gyroradius in equatorial spread F. Interim report.** Huba, J.D.; Chaturvedi, P.K.; Ossakow, S.L.; Towle, D.M. (Naval Research Lab., Washington, DC (USA)). May 1978. 18p. NTIS PC A02/MF A01.

Evidence is given for intense VHF and UHF radar backscatter during equatorial Spread F resulting from irregularities of 1 meter and 36 cm, respectively. The linear theory for high frequency drift waves, generated by the drift-cyclotron and lower-hybrid-drift instabilities, is presented. This linear theory is set forth as a possible explanation for the occurrence of these irregularities below the ion gyroradius. The maximum growth for these instabilities occurs for kr/sub e/ approximately 1, where k is the wavenumber perpendicular to the magnetic field and r/sub e/ is the electron gyroradius. For typical equatorial Spread F ionospheric parameters, the lower-hybrid-drift instability is dominant.

39762 (AD-A—058684) **Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 October 1976—31 December 1977.** Dalgarno, A.; Constantinides, E. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Jun 1978. Contract F19628-77-C-0030. 48p. NTIS PC A03/MF A01.

Under the present contract, a research effort was undertaken to develop theoretical and computational techniques pertaining to the energy balance and plasma motions in the ionosphere. Emphasis has been placed on the utilization of available satellite data as input to the calculations and as a test of the validity of the theoretical methods. The effect of ambipolar diffusion on the O/sub +/ concentration profile has been investigated. Calculations show that diffusive transport produces qualitative agreement between observed and calculated profiles. Additional applications are required to produce definitive results. Procedures for the calculation of the rate of energy deposition by solar EUV flux and of the rate of photoionization of the principal atmospheric constituents have been revised. The associated computer codes have been modified or rewritten. The atomic and molecular cross sections utilized by these codes have been updated. The total photoionization cross section of atomic oxygen was revised significantly. Branching ratios for the photoionization of N_2 and O_2 are substantially different from those used previously. Future work undertaken under contract F19628-78-C-0047 will incorporate electric fields into the transport equations. The study of the spectrum of secondary electrons produced by energetic precipitating particles will be continued under the new contract.

39763 (N—78-28732) **Compilation of ionlab riometer data for IMS workshop in Hankasalmi.** Stauning, P.; Christensen, B. (Danish Meteorological Inst., Copenhagen). May 1977. 47p. NTIS PC A03/MF A01.

Data from riometers located at a net of geophysical observatories in Greenland, Faroe Islands, and North Norway for a number of geophysical events is presented. The tables comprise processed absorption data for some events and photos of raw riometer records for others.

39764 (N—78-30753) **Various measurements of atmospheric parameters from incoherent scattering of nightglow.** Sobral, J.H.A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1977. 15p. NTIS PC A02/MF A01.

A comparison of theoretical and practical results of integrated 300A luminescence show significant variations in the composition of neutral atmospheric constituents. These variations were detected during the occurrence of large ionizing perturbations of the atmosphere. The red emission was calculated from electron density data collected by radar.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 39752, 39753

39765 (AD-A—057975) **Magnetic substorms and ionospheric storms. A measurement network covering at least the entire Pacific area is seen as the key to the development of complete storm morphologies and a prediction capability. Interim report February 1976-January 1978.** Argo, P.E.; Hill, J.R.; Rothmuller, I.J. (California Univ., Davis (USA). Dept. of Land, Air, and Water Resources). 15 May 1978. 40p. NTIS PC A03/MF A01.

Geomagnetic and ionospheric variations are extremely important to the Navy because many C3 and surveillance systems depend upon the stability of the geomagnetic field and ionosphere for reliable operation. For example, rapid geomagnetic pulsations may obscure submarines from our ASW detectors, and ionospheric storm depletions or enhancements of the F-region may compromise covert Naval communications. To alleviate the damaging effects of these variations, a real-time environmental prediction/assessment system must be developed with inputs into a model describing effects of the variations on the system. This report documents the present understanding of both magnetospheric substorms and ionospheric storms, and suggests a program to expedite the development of an operational model for Naval use. Magnetospheric substorms appear to be the causative mechanism of the global ionospheric storm. A digest of the major models of magnetospheric substorms is presented in chapter 1. Chapter 2 discusses the ionospheric storms that are identified with magnetospheric substorms. (Author)

39766 (AD-A—058245) **Lower-hybrid-drift wave turbulence in the distant magnetotail. Interim report.** Huba, J.D.; Gladd, N.T.; Papadopoulos, K. (Naval Research Lab., Washington, DC (USA)). May 1978. 45p. NTIS PC A03/MF A01.

Recent satellite observations of electrostatic and magnetic noise in the distant magnetotail (Gurnett et al., 1976) can be explained by the excitation of the lower-hybrid-drift instability. In particular it is shown that (1) existence conditions for the lower-hybrid-drift instability are met, (2) the observed frequency spectra and polarization are in good agreement with the predictions of linear theory, and (3) the observed amplitudes of fluctuations are consistent with the nonlinear theory of this mode. Moreover, the observation of this instability suggests that the anomalous transport properties associated with these waves, which are important in many laboratory devices, may play a crucial role in the macroscopic evolution of magnetotail processes such as field line merging, tearing instabilities or 'fireballs.'

39767 (PB—286773) **A catalog of low-frequency oscillations of the earth's magnetic field as observed at SMS-1 during November 1974—March 1975. Data report.** Newell, R.E.; Barfield, J.N. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Space Environment Lab.). May 1978. 21p. NTIS PC A02/MF A01.

To facilitate the statistical analysis of ULF magnetic waves observed at the synchronous orbit, and to expedite the selection of suitable intervals for comparison of SMS/GOES data with observations on the ground and on other satellites, a catalog of low-frequency magnetic oscillations observed at the SMS/GOES locations was compiled. This report covers the period November 1974 through March 1975, and includes observations from the satellite SMS-1, which was located at 75 degrees west geographic longitude. Pulsation events are catalogued which display at least five continuous cycles and a frequency which is roughly constant. When different frequencies are present at the same time, each is identified as an event. Only pulsations with a peak amplitude of at least 3 gammas are included in the catalog.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 39366

39768 **Rotational distributions from photodissociations. I. Linear triatomic molecules.** Morse, M.D.; Freed, K.F.; Band, Y.B. (James Franck Institute and Department of Chemistry, University of Chicago, Chicago, Illinois 60637). *J. Chem. Phys.*; 70: No. 8, 3604-3619(15 Apr 1979).

The generalized Franck—Codon theory of the collinear dissociation of linear triatomic molecules is presented, including a proper description of the bending vibrations in the initial bound electronic state and of the rotational motions on both the initial and

the final repulsive electronic surface. The nonseparable multidimensional bound—continuum Franck—Condon integrals are reduced to a rapidly convergent series of products of one dimensional integrals. Analytical expressions are derived for rotational and orbital angular momentum distributions of the products, for scalar coupling (as in predissociations), as well as parallel and perpendicular transitions (as in direct photodissociation). This fully quantum mechanical theory makes explicit the separate and interrelated roles played by angular momentum and energy conservation. The present work is applied in a separate paper to the photodissociation of ICN, and qualitative agrement with experiment is obtained.

39769 Rotational distributions from photodissociation. II. Results for ICN+hν→I+CN(X $^2\Sigma^+$). Morse, M.D.; Freed, K.F.; Band, Y.B. (The James Franck Institute and The Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). *J. Chem. Phys.;* **70**: No. 8, 3620-3629(15 Apr 1979).

The quantum theory of rotational, vibrational, translational and electronic energy distributions in photodissociation is applied to the A continuum photodissociation of ICN. Excited state potential energy surfaces are fitted to the available experimental data, and predictions are made of the product energy distributions. General results are discussed which are applicable to other photodissociations and predissociations. In particular, the calculated rotational energy distributions display a strong sensitivity to the details of the unbound potential surface. The results of the collinear approximation for vibrational distributions in photodissociation of linear molecules are shown to be considerably modified by including rotational degrees of freedom, especially at high photon energies.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 39379, 39397

39770 (AD-A—059882) **Steady state transport of high current beams in a focused channel. Interim report.** Haber, I.; Maschke, A.W. (Naval Research Lab., Washington, DC (USA)). May 1978. 13p. NTIS PC A02/MF A01.

By following the orbits of several thousand particles in their self-consistent space charge fields, the evolution of an unstable Kapchinskij-Vladimirskij distribution is examined until saturation is reached. A distribution is formed which is stable on a scale of hundreds of quadruple magnets.

39771 (LA—7445-C, pp 15-30) **Effects of the Coulomb explosion on the transmission of molecular ions through a tandem.** Middleton, R. (Univ. of Pennsylvania, Philadelphia). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

When foils alone are used to strip a molecular ion beam in a tandem Van de Graaff an energy spread ranging from 20 to over 100 keV will inevitably be introduced into the beam over and above the energy spread caused by straggling. Intensity losses may also occur as a result of the induced angular spread and might become quite severe in cases where the constituents of the molecule have comparable mass. In the absence of charge state selection in the terminal, a light unwanted ion accompanied by a heavy ion might acquire a sufficiently large angular spread that most of it dumps in the high energy acceleration tube leading to excessive loading. Most of these problems can be alleviated by using a relatively low gas flow stripper located before the carbon stripper foil. (GHT)

39772 (LBL—7687) **Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces.** Gale, R.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 150p. Dep. NTIS, PC A07/MF A01.

Thesis.

Reactive and nonreactive gas-surface interactions were studied by modulated molcular beam mass spectrometry on Pt(111) and stepped Pt(111) surfaces under ultra-high vacuum conditions. The angular distribution of helium atoms scattered from the stepped Pt(553) surface was measured as a function of the angle of incidence (polar, θ, and azimuthal, Phi). Rainbow scattering was observed indicating that the ordered array of steps and terraces exhibits a strongly periodic surface potential. In contrast, from the Pt(111) surface, the angular distribution of scattered helium atoms exhibits a sharp peak at the specular angle, characteristic of a smooth and well ordered surface. The interaction of hydrogen with platinum was investigated by studying the H_2-D_2 exchange reaction on the Pt(111) and the two stepped surfaces, Pt(553) and Pt(332). The production of HD was monitored. The mechanism of the H_2-D_2 exchange reaction was investigated on the Pt(111) and stepped Pt(332) surfaces. The dependence of the apparent reaction probability on surface temperature also indicates that the adsorption of hydrogen is an activated process on the Pt(111) surface, but not on the stepped Pt(332) surface. The energy barrier for hydrogen adsorption on Pt(111) deduced from this type of experiment is ~ 1.5 kcal/mole. On both surfaces, the mechanism of the recombination of adsorbed H and D atoms to form HD consists of a branched process at high crystal temperatures, with one of the branches connected in series with another reaction step at low temperatures. The process that isoperative over the entire temperature range studied, 25 to 800°C, has an activation energy and an apparent pre-exponential factor of E_1 = 13.0 +- 0.4 kcal/mole and $A_1 = (8 +- 3) \times 10^4\ sec^{-1}$ for the Pt(332) surface and E_1 = 15.6 +- 0.5 kcal/mole and $A_1 = (2.7 +- 1) \times 10^5\ sec^{-1}$ for the Pt(111) surface. 39 references.

39773 (UCRL—13950) **High peak power pulsed WIP electron gun. Final report, 1 April—1 October 1978.** Wakalopulos, G. (California Univ., Livermore (USA). Lawrence Radiation Lab.). 1978. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

Hughes' experience in high power high pressure CO_2 lasers has resulted in the development of a unique and novel electron gun. It is capable of either pulsed or CW operation at current densities that can be varied by six orders of magnitude by a modulator at ground potential. This device, called the Wire Iron Plasma (WIP) electron gun, was orginally developed in 1974 for a C.W. airborne electrodynamic laser to improve the overall reliability, lifetime and ruggedness of E-beam pumped lasers. The following results have been demonstrated: (a) pulse widths of less than 200 nsec are readily attainable at 150 KV and $1A/cm^2$; (b) grid modulation is feasible but not necessary to obtain short pulses; (c) high repetition rate (10KHZ) operation is feasible, i.e., the plasma decays between pulses.

39774 Microcomputer-based multiplexer for performing depth profiling with an Auger electron spectrometer. Oppenheimer, J.L. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Rev. Sci. Instrum.;* **50**: No. 5, 572-576(May 1979).

A microcomputer-based instrument for the automated profiling of samples with an Auger electron spectrometer and Ion Gun is described. The instrument records the changing heights of spectral peaks as it controls spectrometer scanning over predefined windows. Interactive front panel controls are used to set up a run and control profiling operations. The generated data is stored on a magnetic disk for later analysis and plotting. Implementation of the device using an LSI-11 microcomputer and interfacing hardware is detailed, along with the characteristics of the fortran IV driving software. An exploration of future capabilities and applications of the multiplexer is also given.

39775 Electron impact spectra of some mono-olefinic hydrocarbons). Johnson), K.E.; Johnston, D.B.; Lipsky, S. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *J. Chem. Phys.;* **70**: No. 8, 3844-3858(15 Apr 1979).

Electron impact spectra of ethylene, propylene, isobutene, trans-butene, cis-butene, trimethylethylene, and tetramethylethylene have been obtained at scattering angles of 0° and 90° and at impact energies from ≃20 to 150 eV. The spectra scan an energy-loss region from 2.5—15 eV. All of the observed Rydberg transitions of the methyl derivatives are correlated to corresponding Rydberg transitions of ethylene. The missing $\pi \rightarrow 3p$ transitions of ethylene are tentatively located via this correlation. Evidence is also presented for assigning the N→3R' system of ethylene (at 8.26 eV) to a $\pi \rightarrow 3p$/ sub x/ transition. Possible assignments of some broad continua above ≃8—9eV as $\sigma \rightarrow \pi^*$ and $\sigma \rightarrow \sigma^*$ transitions are considered. In agreement with other reported large-angle electron impact spectra, no evidence is obtained for transitions that could be assigned to triplet Rydberg states. However the $\pi \rightarrow \pi^*$ triplet transitions are all clearly located with transition energies in good agreement with those obtained by a variety of other techniques.

39776 Preferential sputtering of Ta_2O_5 by argon ions. Holloway, P.H.; Nelson, G.C. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Vac. Sci. Technol.;* **16**: No. 2, 793-796(Mar 1979).

X-ray photoelectron spectroscopy has been used to show that Ar^+ preferentially sputters O from the surface to Ta_2O_5. In addition, x-ray photoelectron, Auger electron, ion scattering, and secondary ion mass spectroscopies were used to show that more reduction of Ta_2O_5 is caused by 0.5 keV Ar^+ than by 5 keV Ar^+. This dependence of preferred sputtering upon energy is attributed to changes in the sputtering mechanisms.

39777 Sputtering of two-phase polycrystalline metals. Tortorelli, P.F.; Altstetter, C.J. (Department of Metallurgy and Mining Engineering and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *J. Vac. Sci. Technol.;* **16**: No. 2, 804-807(Mar 1979).

Polycrystalline niobium and its alloys with oxygen have been sputtered with a 15-keV argon ion beam. Yield measurements and scanning electron microscope topographic observations have been made for both single- and two-phase (Nb + NbO) targets which

were also characterized by use of a scanning Auger microprobe. Results indicate that the relative yields of different phases, as well as of different grains, are critically dependent on the direction of the argon beam with respect to the individual grain orientations. Oxygen in solid solution and oxygen-containing atmospheres were important factors which influenced the target topography. The observed differential erosion of grains and the presence of surface relief inside individual grains are discussed with reference to the use of sputtering for depth profiling in surface analysis.

39778 Temperature dependence of alignment production in He I by beam-foil excitation. Gay, T.J.; Berry, H.G. (Department of Physics, University of Chicago, Chicago, Illinois 60637). *Phys. Rev., A;* **19**: No. 3, 952-961(Mar 1979).

We have measured the dependence upon target-foil temperature of the linear polarization fraction (M/I) of the 2s ^{1}S-3p ^{1}P, 5016-A transition in He I for ion energies between 60 and 180 keV. The thin carbon exciter foils were heated externally by Nichrome resistance elements. The measurements of Hight et al. are duplicated; the energy and current dependencies of M/I are the same, assuming correspondence between beam heating and external heating. We also observe that γ, the number of secondary electrons produced per incident ion, decreases with increasing foil temperature. These two effects, in conjunction, offer a plausible explanation for the variation of polarization with beam-current density. The temperature of the foil is shown to depend on beam current to the one-fourth power, indicating that radiation is the primary energy-loss mechanism.

39779 K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4—3.8-MeV/amu $^{10}_{5}$B-ion bombardment. Mehta, R.; McDaniel, F.D.; Duggan, J.L.; Miller, P.D. (Department of Physics, North Texas State University, Denton, Texas 76203). *Phys. Rev., A;* **19**: No. 3, 1363-1366(Mar 1979).

In this Comment we report measurements of K-shell x-ray production cross section, $K\beta/K\alpha$ x-ray intensity ratios and $K\alpha$ and $K\beta$ x-ray energy shifts for $_{29}$Cu, $_{32}$Ge, $_{36}$Br, and $_{37}$Rb for 4—38-MeV $^{10}_{5}$B-ion bombardment. The dominant contribution to target K-shell ionization is believed to be direct Coulomb ionization. Electron-capture contributions to target K-shell ionization are expected to be < or = 7%.

39780 Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode. Johnson, D.J.; Kuswa, G.W.; Farnsworth, A.V. Jr.; Quintenz, J.P.; Leeper, R.J.; Burns, E.J.T.; Humphries, S. Jr. (Sandia Laboratories, Inc. Albuquerque, New Mexico 87115). *Phys. Rev. Lett.;* **42**: No. 9, 610-613(26 Feb 1979).

The production, focusing, and numerical simulation of a 0.5-TW proton beam is reported. This beam is produced with a spherical, magnetically insulated, ion diode fed symmetrically by the dual—pulse-line Proto I generator. The ions are accelerated with electric fields due to a virtual cathode supported by magnetic field surfaces. Approximately 75% of the diode electrical power is delivered to ions and 25% of the ion beam is focused upon thin, 1-cm-diam, 1-cm-long conical targets to produce the first experimental ion-driven implosions.

39781 Sputtering calculations with the discrete-ordinates method. Hoffman, T.J. (Oak Ridge National Lab., TN); Dodds, H.L. Jr.; Robinson, M.T.; Holmes, D.K. *Nucl. Sci. Eng.;* **68**: No. 2, 204-211(Nov 1978).

The purpose of this work is to investigate the applicability of the discrete-ordinates (S/sub N/) method to light ion sputtering problems. In particlar, the neutral particle discrete-ordinates computer code, ANISN, is used to calculate sputtering yields. No modifications to this code are necessary to treat charged particle transport. However, a cross-section processing code is needed for the generation of multigroup cross sections; these cross sections include a modification to the total macroscopic cross section to account for electronic interactions and small-scattering-angle elastic interactions. The discrete-ordinates approach enables calculation of the sputtering yield as functions of incident energy and angle and of many related quantities, such as ion reflection coefficients, angular and energy distributions of sputtering particles the behavior of beams penetrating thin foils, etc. The results of several sputtering problems as calculated with ANISN are presented.

39782 Molecular beam study of the kinetics of the fluorine—uranium dioxide reaction. Machiels, A.J.; Olander, D.R. (Univ. of California, Berkeley). *High Temp. Sci.;* **9**: No. 1, 3-25(Mar 1977).

The kinetics of uranium dioxide fluorination were studied using a modulated molecular beam of fluorine with equivalent pressure up to 10^{-4} torr directed at a uranium dioxide single crystal wafer heated to 1800°K and maintained in high vacuum. Gaseous reaction products were monitored by a quadrupole mass spectrometer. Phase-lock detection was employed to enhance the signal-to-noise ratio and to measure surface residence times. No reaction was observed at temperatures below 1000°K. From 1000 to 1600°K, uranium tetrafluoride was the sole reaction product detected, but the presence of undetectable atomic fluorine was inferred from the data. The reaction model developed to explain the data included: coverage-dependent dissociative adsorption of F_2 on the UO_2 surface; surface diffusion of F atoms to reaction zones where reaction to produce UF_4 and F occurred; and bulk solution-diffusion of adsorbed F atoms. No effect of crystallographic orientation of the UO_2 was observed. 30 references.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 39931

39783 (CONF-790344—1) **Negative ions of polyatomic molecules.** Christophorou, L.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). 1979. Contract W-7405-ENG-26. 80p. Dep. NTIS, PC A05/MF A01.

From Conference on fundamentals and applications of negative ions in mass spectra; Chapel Hill, NC, USA (22 Mar 1979).

General concepts relating to, and recent advances in, the study of negative ions of polyatomic molecules are discussed with emphasis on halocarbons. The outline of the paper is as follows: basic electron attachment processes, modes of electron capture by molecules, short-lived transient negative ions, dissociative electron attachment to ground-state molecules, dissociative electron attachment to hot molecules (effects of temperature on electron attachment), parent negative ions, effect of density, nature and state of the medium on electron attachment, electron attachment to electronically-excited molecules, the binding of attached electrons to molecules (electron affinity), and the basic and the applied significance of negative-ion studies. 133 references.

39784 (LBL—8208) **Vibrational energy transfer in selectively excited diatomic molecules.** Dasch, C.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1978. Contract W-7405-ENG-48. 257p. Dep. NTIS, PC A08/MF A01.

Thesis.

Single rovibrational states of HCl(v=2), HBr(v=2), DCl(v=2), and CO(v=2) were excited with a pulsed optical parametric oscillator (OPO). Total vibrational relaxation rates near - resonance quenchers were measured at 295°K using time resolved infrared fluorescence. These rates are attributed primarily to V - V energy transfer, and they generally conform to a simple energy gap law. A small deviation was found for the CO(v) + DCl(v') relaxation rates. Upper limits for the self relaxation by V - R,T of HCl(v=2) and HBr(v=2) and for the two quantum exchange between HCl and HBr were determined. The HF dimer was detected at 295°K and 30 torr HF pressure with an optoacoustic spectrometer using the OPO. Pulsed and chopped, resonant and non-resonant spectrophones are analyzed in detail. From experiments and first order perturbation theory, these V - V exchange rates appear to behave as a first order perturbation in the vibrational coordinates. The rotational dynamics are known to be complicated however, and the coupled rotational - vibrational dynamics were investigated theoreticaly in infinite order by the Dillon and Stephenson and the first Magnus approximations. Large ΔJ transitions appear to be important, but these calculations differ by orders of magnitude on specific rovibrational transition rates. Integration of the time dependent semiclassical equations by a modified Gordon method and a rotationally distorted wave approximation are discussed as methods which would treat the rotational motion more accurately. 225 references.

39785 Diatomic-molecule vibrational potentials. II. New representationsa). Engelke, R. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **70**: No. 8, 3745-3757(15 Apr 1979).

Two new representations of diatomic-molecule vibrational potentials are presented. One of these includes most of the previously employed series approximations as special cases. The new representations are tested against older ones by using Peek's "exact" numerical Born—Oppenheimer potentials for the $1s\sigma$/sub g/, $2p\pi$/sub u/, and $3d\sigma$/sub g/ states of H_2^+ as test problems. Accuracy comparisons are made with Dunham, Thakkar, Ogilvie—Tipping, Coulomb-subtracted Ogilvie—Tipping, and Pade representations. A central idea of the new treatment is that it is not necessary to use a global representation of the potential over the region 0< or =R/R/sub e/<∞. Rather one can choose separate representations suitable for the subregions R/R/sub e/< or =1 and R/R/sub e/> or =1 and then match them smoothly to each other and to the Dunham expansion at R/R/sub e/=1. Attention is focused on finding improved approximations for R/R/sub e/>1, since this region exerts strong control on the vibrational eigenvalue spectrum and it is here, perhaps, where the older techniques are at their weakest. Known properties of the exact potential such as the R$\rightarrow\infty$ behavior and the dissociation energy can be built into the new forms a priori. If the dissociation energy is not known, the new methods allow it to be estimated with better accuracy then could be done previously. If one

knows only Dunham coefficients, the Coulomb-subtracted Ogilvie—Tipping series is the superior representation. If one knows, in addition, the dissociation energy, the new representations are superior and give more accurate results on the interval R/R/sub e/> or =1.

39786 Carbon reaction studied by crossed molecular beams). Krause, H.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **70**: No. 8, 3871-3880(15 Apr 1979).

The chemiluminescent reaction $C_2+NO \rightarrow CN(B\ ^2\Sigma^+)+CO+2.89$ eV has been studied in a crossed molecular beam configuration. The carbon beam was obtained from a graphite sublimation source operating at 2550° K. The beam (principally C, C_2, C_3) was pulsed by a rotating slotted disk before it crossed the NO beam. Electronically excited molecules formed in reaction, CN(B $^2\Sigma^+$), were detected as they rapidly decayed to the ground state. Photon time-of-arrival measurements identified the reactant as C_3. The vibrational energy disposal within CN(B $^2\Sigma^+$) was derived from wavelength resolved measurements. Reaction energetics and the signal intensity indicated the companion product, CO($X^1\Sigma$). This study indicates that energy deposition into vibrational degrees of CN(B $^2\Sigma^+$) disagrees mildly with "prior expectation" (Levine, Bernstein, and co-workers). The reaction probably proceeds on a potential energy surface that correlates to $C_2(X'\ ^3Pi/sub\ u/)+NO(X\ ^2Pi)$.

39787 Hyperfine structure measurements of high-lying levels of uranium. Hackel, L.A.; Bender, C.F.; Johnson, M.A.; Rushford, M.C. (Lawrence Livemore Laboratory, P. O. Box 5508, Livermore, California 94550). *J. Opt. Soc. Am.;* **69**: No. 2, 230-232(Feb 1979).

A technique for precisely measuring hyperfine structure of any level of neutral uranium which can be excited by a single or multistep transition from the ground or a low-lying-metastable state has been developed. Numerous spectra were measured and fit to obtain precise hyperfine splitting constants. In particular, measurements on the 31 869-cm^{-1} odd level have determined the following: J = 6, magnetic dipole constant A = -47.2 +- 0.6 MHz and electric quadrupole c tant B = 1892 +- 26 MHz. Structure of serveral excited states of known configuration were measured including the 1532-cm^{-1} $f^3d^2s^2(^5L_7)$ and the 16 930-cm^{-1} f^3dsp ($^7K_8$) levels.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 39783

39788 (AD-A—059845) Molecular beam studies of low energy reactions. Annual summary report. Neynaber, R.H.; Tang, S.Y. (IRT Corp., San Diego, CA (USA)). 2 Oct 1978. Contract N00014-74-C-0011. 5p. NTIS PC A02/MF A01.

Chemi-ionization and ion-molecule reactions involving metastable and ground-state atoms are studied by both crossed and merging beams at low relative energies (i.e., 0.01 to 10 or 20 eV).

39789 (CONF-790438—1) Theory of electron transfer and ionization. Becker, R.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From DOE/BES research meeting on high energy atomic physics; Manhattan, KS, USA (5 Apr 1979).

The main effort reported is directed toward charge transfer and ionization in high energy atomic collisions. The research may be divided into classical trajectory calculations, quantum - mechanical collision theory, and phenomenological treatments of quantal interference effects in heavy ion collisions.

39790 (COO—2640-10) Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978—April 30, 1979. Gentry, W.R. (Minnesota Univ., Minneapolis (USA)). Jan 1979. Contract EY-76-S-02-2640. 15p. Dep. NTIS, PC A02/MF A01.

A program of research was undertaken to study the dynamics of the reactions of ions with atomic and molecular free radicals, using a merged molecular beam technique. The objectives of this research are to obtain fundamental information on reaction mechanisms in reactions of species having open-shell electronic configurations, and to investigate the importance of electronic nonadiabaticity in chemical reactions. During the present contract year work was done on completing studies of the reaction $D_2^+ + F(^2P) \rightarrow FD^+ + D$ and of the complementary reactions $D_2^+ + HF \rightarrow FD_2^+ + H$, $D_2^+ + HF \rightarrow FHD^+ + D$, and $D_2^+ + HF \rightarrow FD^+ + HD$. Also some experiments were carried out on the reaction $C^+ + D_2 \rightarrow CD^+ + D$ to complement our previous work on the opposite initial charge state of the system, $D_2^+ + C \rightarrow CD^+ + D$. Finally, as an aid in interpreting our merged-beam data at kinetic energies as low as 0.002 eV. A theoretical analysis was performed of the differential cross sections for ion-dipole capture collisions followed by direct-mode reactions. The results indicate that shifts in the product angular distribution with a change in the reactant kinetic energy do not necessarily imply a change in the short-range reaction mechanism. A list of publications is included.

39791 (COO—2718-7) Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978—May 31, 1979. Leventhal, J.J. (Missouri Univ., St. Louis (USA)). Feb 1979. Contract EY-76-S-02-2718. 22p. Dep. NTIS, PC A02/MF A01.

Recent experiments on energy transfer processes in atomic and molecular interactions are described. Of particular interest are the results of studies involving energetically excited atoms. Using laser excitation, collisions between excited sodium atoms were found to form both ionic and highly excited neutral products, neither of which is energetically possible unless both reactant atoms are excited. It is shown that energy from the laser beam is stored in sodium atoms and returned to the system in subsequent collisions between excited species.

39792 (LA—7445-C, pp 3-13) Absolute charge state yields of 20 MeV ^{127}I ions emerging from a gas stripper. Moak, C.D. (Oak Ridge National Lab., TN). Sep 1978.

From SNEAP conference; Los Alamos, NM, USA (26 Sep 1977).

Charge state studies with heavy ion beams in tandem accelerator stripper canals are reported for 20 MeV ^{127}I. Comparison of yields is given for solid and gaseous stripper materials. (GHT)

39793 (LA—7727-T) Photoionization mass spectrometric studies of selected compounds in a molecular beam. Trott, W.M. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 240p. Dep. NTIS, PC A11/MF A01.

Photoionization efficiency curves have been measured at moderate to high resolution for several species produced in supersonic molecular beams of acetone, acetone-d_6 and CS_2. The molecular beam photoionization mass spectrometer which has been assembled for this work is described. The performance of this instrument has been characterized by a number of experiments and calculations.

39794 (LBL—7686) Molecular beam studies of unimolecular reactions: Cl, F + C_2H_3Br. Buss, R.J.; Coggiola, M.J.; Lee, Y.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 32p. (CONF-790411—1). Dep. NTIS, PC A03/MF A01.

From Faraday general discussion No. 67 "Kinetics of State-Selected Species"; Birmingham, UK (9 Apr 1979).

Several methods currently used to study unimolecular decomposition in molecular beams are discussed. Experimental product angular and velocity distributions obtained for the reaction of F, Cl with C_2H_3Br are presented. The mechanism by which conservation of angular momemtum can cause coupling of the product angular and velocity distributions in dissociation of long-lived complexes is introduced. 14 references.

39795 (LBL—8932) Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu. Alonso, J.; Dietrich, D.; Gould, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 4p. (CONF-790327—91). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Preliminary cross sections for single electron pickup and loss are presented for Fe, Kr and Xe ions at 8.5 MeV/amu and for Ar ions at energies from 3.4 MeV/amu to 8.5 MeV/amu passing through nitrogen gas.

39796 (UCRL—13965) Inverse bremsstrahlung absorption rate in an intense laser field. Schlessinger, L.; Wright, J. (R and D Associates, Marina del Rey, CA (USA)). Nov 1978. Contract W-7405-ENG-48. 41p. (RDA-TR—108600-001). Dep. NTIS, PC A03/MF A01.

Inverse bremsstrahlung is one of the important mechanisms for transferring energy from laser light to matter. The computer code LASNEX currently uses a simple physical model for this process for which there can be substantial corrections. The purpose of this investigation is to provide a model for the bremsstrahlung process that will be applicable over the whole range of interest for use in LASNEX. The derivation of the bremsstrahlung cross section and various approximate forms useful in the numerical calculations, and derivation of the expression for the energy absorption rate for a general distribution function and special forms for various approximations to the cross section are presented. The alternative methods of derivation of the energy absorption rate are discussed. Numerical results are presented along with comparison among the different expressions, and the validity of the assumptions and methods to relax the approximations are discussed.

39797 Theoretical cross sections for ionization of metastable excimers Ne^*_2 and Ar^*_2 by electron impact. McCann, K.J.; Flannery, M.R.; Hazi, A. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Appl. Phys. Lett.;* **34**: No. 9, 543-545(1 May 1979).

Cross sections for the ionization of the metastable excimers Ne^*_2(/sup 1,3/Σ^+/sub u/) and Ar^*_2(/sup 1,3/Σ^+/sub u/) by electron impact are calculated in the binary-encounter approximation for collision energies E (eV) in the range 5< or =E< or =50 eV. They have maximum values $\sim 10^{-15}$ cm^2 and are within 50% higher than the cross sections for ionization of the corresponding metastable atomic states.

39798 Many-electron aspects of molecular promotion in ion-atom collisions: Production of core-excited states of Li in Li^+-He collisions. Elston, S.B.; Schumann, S.; Vane, C.R. (The University of Tennessee, Knoxville, Tennessee 37916). *Phys. Rev., A;* **19**: No. 3, 962-969(Mar 1979).

Production of core-excited autoionizing states of neutral Li having configurations of the form 1snln'l' has been observed over the impact-energy range from 10—50 keV. Although the results for production of all such states is remarkably consistent with a quasi-molecular-excitation model proposed by Stolterfoht and Leithaeuser, production of individual lines in the observed spectra exhibits collision-velocity dependencies indicative of considerably more complex processes, including processes which appear to be inherently two electron in nature. Excitation functions are presented for the $(1s2s^2)^2S$, 1s $(2s2p^3P)^2P$, 1s $(2s2p^1P)^2P$, and $(1s2p^2)^2D$ core-excited states of Li and for total core excitation.

39799 Impact-parameter dependence of K-vacancy production in Cu-Ni collisions. Annett, C.H.; Curnutte, B.; Cocke, C.L. (Kansas State University, Manhattan, Kansas 66506). *Phys. Rev., A;* **19**: No. 3, 1038-1047(Mar 1979).

We have measured the impact-parameter (b) dependent probabilities (P) for the production of Ni (and Cu) K x rays in the bombardment of thin nickel foils by 50- and 65.5-MeV Cu beams. The shape of P (b) is found to be independent of nickel-foil thickness (t) and of the presence of a pre-exciting carbon layer, but the magnitude scale of both P (b) and of the total K-x-ray cross section is quite dependent upon t and on the presence of the carbon. The data suggest that $2p\sigma$ vacancies are being produced via $2p\pi$ - $2p\sigma$ rotational coupling preceded by preparation of the necessary projectile 2p vacancies in both single- and multiple-collision processes. The shape of P (b) is only qualitatively similar to that expected for the rotational-coupling process, however.

ATOMIC AND MOLECULAR THEORY

39800 (AD-A—059533) **The evaluation of matrix elements with generalized spherical Gaussian wavefunctions Part I. Single-particle, one- and two-centre forms. Technical report no. 1, 1 May 77—31 Apr 78.** Schmidt, P.P. (Oakland Univ., Rochester, MI (USA). Dept. of Chemistry). 28 Aug 1978. Contract N00014-77-C-0293. 19p. NTIS PC A02/MF A01.

General expressions are provided for the two-centre matrix elements for the unity (i.e., overlap), kinetic, and electrostatic potential energy operators evaluated in terms of the elements of a general set of Gaussian functions of the form r r/sup 2l+1/ Y/ sub lm (r) $\exp(-\alpha r^2)$. The formulae derived are valid for all orders of n, l, and m. The single centre forms follow automatically from the two-centre forms in the vanishing separation limit.

39801 (IS-T—852) **Systematic determination of extended atomic orbital basis sets and application to molecular SCF and MCSCF calculations.** Feller, D.F. (Ames Lab., IA (USA)). Jan 1979. Contract W-7405-ENG-82. 119p. Dep. NTIS, PC A06/MF A01.

The behavior of the two exponential parameters in an even-tempered gaussian basis set is investigated as the set optimally approaches an integral transform representation of the radial portion of atomic and molecular orbitals. This approach permits a highly accurate assessment of the Hartree-Fock limit for atoms and molecules.

39802 (LA-UR—79-218) **Analytic coherent states for generalized potentials.** Nieto, M.M.; Simmons, L.M. Jr. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 29p. (CONF-7804122—1). Dep. NTIS, PC A03/MF A01.

From Symposium on the foundation of radiation theory and quantum electrodynamics; Boulder, CO, USA (28 Apr 1978).

A prescription is given for finding coherent states in generalized potentials. By coherent states is meant states which in time follow the motion that a classical particle would. This prescription is based upon finding those natural classical variables which vary as the sine and the cosine of the classical ω/sub c/t. As an example, the symmetric Rosen—Morse potential is discussed in detail.

39803 (UCRL-Trans—11473) **Electron transfer in a superdense nondegenerate plasma.** Ermakov, V.V.; Kalitkin, N.N. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). Mar 1979. Translation of Elektronnyi perenos v sverkhplotnoi nevyrozhdennoi plasme, Institute of Applied Mathematics, Academy of Sciences, USSR, Unnumbered Preprint, 44 pages (1977). 34p. Dep. NTIS, PC A03/MF A01.

A physical model is suggested which describes the conductivity and electron heat conductivity of an equilibrium, nondegenerate plasma in the density range from gas densities to superhigh densities, and at all temperatures. In this model, the degree of ionization of the matter is found on the basis of the static Thomas-Fermi model of the atom with quantum and exchange corrections (and, at low densities and temperatures, is refined by means of the Saha equations). The interaction of the charged particles, which may be quite strong, is described by the Debye potential. The transport coefficients are determined from the Boltzmann equation in the fourth approximation of Chapman and Enskog, and quantum effects are used to calculate the scattering cross sections. This method is used to calculate the transfer properties of a number of substances (Be, Al, Si, Ar, Cu, Xe, Cs, Pb, SiO_2, NaCl) at densities of 10^{17} cm^{-3} to 10^{24} cm^{-3}. In the gas area, where direct experimental measurements are available, the good accuracy of these calculations has been confirmed by comparison with experiments. 20 references, 10 figures, 2 tables.

39804 Development of basis sets for molecular calculations. Comparison of tetrahedral Gaussian lobe functions and Cartesian Gaussian basis sets. Spangler, D.; Christoffersen, R.E. (Univ. of Kansas, Lawrence). *Int. J. Quant. Chem., Symp.;* No. 5, 127-135(1978).

In order to allow development of a range of basis sets for use of floating spherical Gaussian orbitals in molecular calculations, an analysis of numerical errors that result from using off-center functions was carried out. This analysis included both rotational variance and numerical differencing problems that can arise when lobe functions are employed. The analysis and numerical studies indicated that satisfactory accuracy in integral evaluation can be maintained if the ratio of distance from the origin to orbital radius is taken to be in the range 0.002 to 0.005 for computers having 72-bit words. 2 figures, 1 table.

39805 Graph-theoretical analysis of structure--property and structure--activity correlations. Randic, M. (Ames Lab., IA). *Int. J. Quant. Chem., Symp.;* No. 5, 245-255(1978).

An exposition of a potentially useful graph-theoretical method for comparing structures is given. The concept of rigorous comparison of sequences, introduced into mathematics by Muirhead and generalized by Karamata, is applied to contributing terms in bond-additive schemes. Such an approach illuminates the origin for occasional deviations in the trends for structure—property and structure—activity correlations. The method is illustrated on the trends of boiling points and heats of vaporizations in hexane and heptane isomers and the corresponding trends for molecular connectivity indices of the molecules considered. The outlined concept of comparability of structures not only clarifies a posteriori occasional discrepancies in correlations, but may also a priori suggest circumstances when one cannot expect simple bond additivity. With the help of the comparability tests the empirical curve-fitting procedures no longer need be based on guessing, intuition, and analogy, since necessity for additional parameters in such schemes can be assessed in advance. 2 figures, 8 tables.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 39958

39806 (UCID—18161) **Appendices to "On the dependence of necking upon loading history".** Hopper, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1979. Contract W-7405-ENG-48. 5p. Dep. NTIS, PC A02/MF A01.

Appendix 1, Pexider's Fourth Equation, provides a brief outline, following Aczel's text [Aczel, J. Lectures on Functional Equations and their Applications, New York: Academic Press, 1966, sec. 2.1 and 3.1], of the solution of Pexider's fourth functional equation, f(xy) = g(x)h(y). Appendix 2, Equations for the Two-Viscosity Fluid, presents the equations giving the radius of the uniform part of the rod when the neck has zero radius; the equations are not derived. Appendix 3, Incompressible Maxwell Fluid, solves for the rate of total strain and integrates the result with respect to time. (RWR)

39807 Semiclassical statistical mechanics of fluids: Nonperturbative incorporation of quantum effects in classical many body models. Stratt, R.M. (Department of Chemistry and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **70**: No. 8, 3630-3638(15 Apr 1979).

Some of the basic equations of the equilibrium statistical mechanics of fluids involving the radial distribution function are derived in a nonperturbative semiclassical form by employing the phase space sampling approach in conjunction with a semiclassical pairwise interaction approximation. Analysis of the approximation suggests two practical models for effective potentials which auto-

matically introduce the desired quantum effects into the classical equations.

39808 Simple probe for fluidized bed measurements0. Dutta, S. (New Jersey Inst. of Tech., Newark); Wen, C.Y. *Can. J. Chem. Eng.;* **57**: 115-119(1979).

The development of an analytical probe which is small in dimensions, sturdy in construction, extremely simple in construction and installation, and versatile in application is described. The probe contains a light emitting diode and a photocell as the sensing element. The complete proble assembly, construction details, and the electronic circuit are given. The probe may be made as small as needed, is ideal in shape, is absolutely free from noise. Three such LED probes can be assembled to construct a single triple-prove assembly that would give direct measurements of bubble sizes in a fluidized bed. (JSR)

39809 (UCRL-Trans—11468) **Variational approach to the construction of difference systems for hydrodynamic equations in spherical coordinates.** Goloviznin, V.M.; Tishkin, V.F.; Favorskii, A.P. 1977. Translation of Preprint No. 16, 1977. 49p. Dep. NTIS, PC A03/MF A01.

Difference systems are generated for equations of non-dissipative hydrodynamics. The equations are written in spherical coordinates (R, θ, psi) in the axisymmetrical case, i.e., the case in which the desired quantities are independent of psi. A variational approach is used to produce the difference systems. 9 figures.

PROPERTIES AND STRUCTURE OF FLUIDS

39810 (SAND—79-0382) **Anisotropic constitutive equation for use in finite difference wave propagation calculations.** Swegle, J.W.; Hicks, D.L. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract AC04-76DP00789. 31p. Dep. NTIS, PC A03/MF A01.

An anisotropic constitutive relation was incorporated into the Lagrangian finite-difference wavecode TOODY. The details of the implementation of the constitutive relation in the wavecode and an example of its use are discussed. 4 figures, 1 table.

MAGNETOHYDRODYNAMICS

39811 (N—78-28388) **Inviscid fluid motions induced by an electric current source. Part I. Preliminary analysis.** Jansen, A.J.M. (Technische Hogeschool Delft (Netherlands)). Jun 1977. 68p. NTIS PC A04/MF A01.

The flow induced by an electric current source and its influence on the current density in an incompressible, inviscid medium were studied. The inviscid and viscous problems have no length or velocity scale and the solutions can be put in a similarity form. Detailed analytic study of the inviscid problem shows that the MHD equations, under the usual approximations, lead to solutions which have weak singularities at the axis of symmetry. The result is that in a neighborhood of the axis of symmetry of order of the Debye length the space charge density can not be neglected, so that in the equation of Euler the Coulomb force and the Lorentz force and in Ohm's law the convection current density and the current density become of equal order. This does not necessarily imply that this problem is not self-similar and that a different near and far field will occur. It might also be an explanation for the physically unrealistic phenomena which appear in the viscous problem.

39812 Weak discontinuities in magneto-gasdynamics with finite electrical conductivity. Shankar, R.; Prasad, M. (Indian Inst. of Technology, Hauz Khas, India). *Int. J. Eng. Sci.;* **17**: No. 1, 17-21(1979).

Following Elcrat the phenomena associated with the weak discontinuities in inviscid non-heat conducting gas with finite electrical conductivity have been studied here. The differential equations for growth and decay of weak discontinuities have been formulated. In order to integrate them in full generality they are transformed to an equation along the bi-characteristic curve in the characteristic manifold SIGMA = US(t). These equations have been solved completely. The criteria for decay or blow up of weak discontinuities are given. The role of finite electrical conductivity is to cause damping.

SUPERFLUIDITY

39813 (LA—7691-PR) **Low temperature physics and engineering. Quarterly progress report, July 1—September 30, 1978.** Keller, W.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 36p. Dep. NTIS, PC A03/MF A01.

This report summarizes the significant progress achieved in several programs carried out in the Los Alamos Scientific Laboratory's Low Temperature Physics and Cryogenic Engineering Group (Q-10) during the period July 1 to September 30, 1978. Progress is documented for the following areas: superfluid helium hydrodynamics; equation of state of helium at high pressure; helium—tritium complex formation; magnetic studies of solids at low temperature; muon spin rotation studies; experiments dealing with the destruction of superconductivity by current; development of conductors, electrical control apparatus, large Dewar vessels, and magnet coils for superconducting magnetic energy storage devices, as well as designs of these units for power system stabilization; design, testing, and procurement of equipment for separating and handling large amounts of tritium—deuterium mixtures for systems to be used in conjunction with tokamak fusion reactors; and experiments leading to designs for magnetic refrigerators to be used for superconducting device applications in the electric power industry.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

39814 (COO—2232A-78) **Experimental physics. Annual report, July 1, 1978—March 1, 1979.** Cool, R.L. (Rockefeller Univ., New York (USA). Dept. of Physics). 1979. Contract EY-76-C-02-2232. 4p. Dep. NTIS, PC A02/MF A01.

Experimental research in high energy physics is summarized. (JFP)

ELECTROMAGNETIC INTERACTIONS

39815 (SLAC-PUB—2218) **Parity violation in inelastic scattering of polarized electrons.** Prescott, C.Y. (Stanford Linear Accelerator Center, CA (USA)). Oct 1978. Contract EY-76-C-03-0515. 56p. (CONF-7806134—1). Dep. NTIS, PC A04/MF A01.

From 6. Treiste conference on particle physics; Trieste, Italy (26 Jun 1978).

Parity nonconservation was observed in the inelastic scattering of longitudinally polarized electrons from an unpolarized deuterium target at 19.4 and 22.2 GeV. An asymmetry $A = (\sigma/\text{sub R/} - \sigma/\text{sub L})/(\sigma/\text{sub R/} + \sigma/\text{sub L/}) = (-9.5 +- 1.6) \times 10^{-5} Q^2$, Q^2 in $(GeV/c)^2$ was found for values of Q^2 near 1.4. The statistical and systematic errors are each about 9 percent of the measured asymmetry. This result is consistent with predictions from the standard Weinberg—Salam SU(2) x U(1) model. Using the simple quark-parton model of the nucleon, the value $\sin^2\theta/\text{sub W/} = 0.20 +- 0.03$ is obtained. 21 references.

39816 Exclusive vector-meson production in muon-proton scattering. del Papa, C.; Dorfan, D.; Flatte, S.M.; Grillo, A.; Heusch, C.A.; Lieberman, B.; Moss, L.; Schalk, T.; Seiden, A.; Bunnell, K.; Duong-van, M.; Mozley, R.; Odian, A.; Villa, F.; Wang, L.C. (University of California, Santa Cruz, California). *Phys. Rev., D;* **19**: No. 5, 1303-1316(1 Mar 1979).

From a muon-proton scattering experiment with a streamer chamber at the Stanford Linear Accelerator we present results in the ranges $0.3 < Q^2 < 4.7$ GeV^2 and $1.7 < W < 4.7$ GeV for the reactions $\mu^+ p \rightarrow \mu p V$ where V is a vector meson (rho^0, ω, or phi). It is shown that in rho production the skewing parameter and the longitudinal-transverse ratio change significantly as Q^2 increases above 1 GeV^2. The cross section for rho^0 production as a function of Q^2 falls below the vector-meson-dominance prediction. The ratio of the cross section for exclusive vector-meson production to the total cross section falls by a factor of 10 between photoproduction and a Q^2 of 2 GeV^2, yet the ratio of ω to rho production remains constant at the photoproduction value out to $Q^2 > 2$ GeV^2.

39817 Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV. Caldwell, D.O.; Cumalat, J.P.; Eisner, A.M.; Lu, A.; Morrison, R.J.; Murphy, F.V.; Yellin, S.J.; Davis, P.J.; Donnelly, M.G.; Egloff, R.M.; Luste, G.J.; Martin, J.F.; Prentice, J.D.; Nash, T. (University of California, Santa Barbara, California 93106). *Phys. Rev. Lett.;* **42**: No. 9, 553-556(26 Feb 1979).

We have measured total hadronic photoproduction cross sections on carbon, copper, and lead. Tagged-photon energies ranged from 20 to 185 GeV for copper and from 45 to 82 GeV for carbon and lead. The energy and A dependence of shadowing were computed by comparing these results to the hydrogen cross section as measured nearly simultaneously with the same apparatus. We observed somewhat more shadowing than did most experiments at lower photon energies.

39818 Upper limit for the decay $\mu^+ \rightarrow e^+\gamma$. Bowman, J.D.; Cooper, M.D.; Hamm, M.; Hoffman, C.M.; Mischke, R.E.; Nagle, D.E.; Sarracino, J.S.; Thompson, P.A.; Anderson, H.L.; Kinnison, W.W.; Matis, H.S.; Wright, S.C.; Carrington, R.L.; Eichler, R.A.; Hofstadter, R.; Hughes, E.B.; McPharlin, T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **42**: No. 9, 556-560(26 Feb 1979).

An examination of 3.6 x 10^{10} μ^+ decays yields an improved upper limit for the branching ratio Γ ($\mu^+ \rightarrow e^+ \gamma$)/$\Gamma$ ($\mu^+ \rightarrow e^+ \nu$/sub e/nu-bar/sub μ/) < 1.9 x 10^{-10} with 90% confidence.

WEAK INTERACTIONS

39819 (BNL—24848) **Neutrino—deuterium reactions in the 7-foot bubble chamber.** Cnops, A.M.; Connolly, P.L.; Kahn, S.A.; Kirk, H.G.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tanaka, M. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 15p. (CONF-780762—8). Dep. NTIS, PC A02/MF A01.

From Conference on neutrino physics at accelerators; Oxford, UK (3 Jul 1978).

Recent results are reported from the analysis of 569,000 ν pictures taken in the BNL 7-ft bubble chamber filled with D_2 (and an additional 204,000 pictures in H_2). The statistics of current analysis include 648 quasielastic ν/sub μ/ d $\rightarrow$ μ^- pp/sub s/ events and 25 events with visible strangeness present. Using the quasielastic events in the framework of the conventional V-A theory, the values M/sub V/ = 0.87 +- 0.09 GeV and M/sub A/ = 1.03 +- 0.19 GeV are found. The value is in good agreement with the CVC prediction of M/sub V/ = 0.84 GeV. With the fixed value of M/sub V/ = 0.84 GeV, a one-parameter fit yields M/sub A/ = 1.08 +- 0.08 GeV. Also 8 events are found in the exclusive channel $\nu n \rightarrow \mu^- K^+ \Lambda$ in agreement with a theoretical calculation using the generalized Born approximation. 30 references.

39820 (COO—3071-237) **Recent results on neutrino reactions.** Mann, A.K. (Pennsylvania State Univ., University Park (USA). Dept. of Physics). 1978. Contract EY-76-C-02-3071. 18p. (CONF-780826—30). Dep. NTIS, PC A02/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

A review is given of inclusive muon neutrino and antineutrino interactions with nucleons. Included are cross sections, the y distribution, multiple muon production, and anti- and strange-quark phenomena. (JFP)

39821 **Search for short-lived particles in high-energy neutrino interactions identified using a hybrid emulsion—spark-chamber arrangement.** Read, A.L.; Coremans-Bertrand, G.; Sacton, J.; Vilain, P.; Breslin, A.; Montwill, A.; Garbutt, D.A.; Burhop, E.H.S.; Davis, D.H.; Tovee, D.N.; Stannard, F.R.; Blaes, G.; Klein, R.; Schmitt, F.M.; Baroni, G.; Ceradini, F.; Conversi, M.; DiLiberto, S.; Federici, L.; Ferrer, M.L.; Gentile, S.; Petreta, S.; Romano, G.; Santonico, R.; Bassompierre, G.; Jung, M.; Kurtz, N.; Paty, M.; Schneegans, M. (Fermi National Accelerator Laboratory, Batavia, Illinois). *Phys. Rev., D;* **19**: No. 5, 1287-1302(1 Mar 1979).

Seventeen litres of nuclear photographic emulsion have been exposed to the wide-band neutrino beam at Fermilab. Tracks of secondaries from neutrino interactions in the emulsion were observed in a wide-gap spark chamber and a system of narrow-gap spark chambers and counters down beam. From measurements on the tracks in the wide-gap chamber the positions of vertices from which the secondaries diverged were predicted and 37 neutrino interactions in emulsion were located. Factors affecting the efficiency of location of events searched for (~20% in this experiment) are assessed and conclusions drawn about means of optimizing the design of experiments employing emulsion hybrid techniques. In one of the interactions a secondary track gave rise to three tracks after a distance of 182 μm. Further measurements made on this event do not alter the previous conclusion of its most likely interpretation as the decay of a short-lived particle of lifetime ~6 x 10^{-13} sec.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 39377, 39454

39822 (BNL—25879) **(K,π) reaction at Brookhaven.** May, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790347—7). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

The strangeness exchange reaction (K^-,π^-) was used to study the spectrum of ^{12}C. The angular distributions of the ground state and the peak at 11 MeV excitation were measured. Evidence is found for the existence of two components of the 11 MeV peak, and also for a new state or states 4.4 +- .5 MeV excitation. Results of searches for the sigma hypernucleus /sub Σ^-/^{12}C and for bound states of the Σ^- neutron system are discussed. 10 references.

39823 (COO—2232A-67) **Results on correlations and jets in high transverse momentum p-p collisions at the CERN ISR.** Angelis, A.L.S.; Blumenfeld, B.J.; Cool, R.L. (European Organization for Nuclear Research, Geneva (Switzerland); Rockefeller Univ., New York (USA)). 29 Sep 1978. Contract EY-76-C-02-2232. 32p. (CONF-780826—29). Dep. NTIS, PC A03/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

A large solid-angle apparatus consisting of a superconducting solenoid magnet, cylindrical drift chambers, and two arrays of lead-glass counters is used to examine particles associated with a high transverse momentum trigger in pp interactions at the CERN ISR. The trigger is given by energy deposition in the lead-glass arrays centered at 90°. Results on particle correlations and on jets are presented for interactions at $\sqrt{s}$ = 62.4 GeV and in the trigger transverse momentum range 3 < p/sub T/ < 11 GeV/c. 20 references.

39824 (COO—2232A-68) **Measurement of inclusive π^0 production at large p/sub T/ from p-p collisions at the CERN ISR.** Angelis, A.L.S.; Blumenfeld, B.J.; Cool, R.L. (European Organization for Nuclear Research, Geneva (Switzerland); Rockefeller Univ., New York (USA)). 1978. Contract EY-76-C-02-2232. 24p. (CONF-780826—28). Dep. NTIS, PC A02/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

An apparatus consisting of a superconducting solenoidal magnet, cylindrical drift chambers and two arrays of lead glass Cerenkov counters at the CERN ISR has been used to study p-p collisions in which a π^0 of large p/sub T/ is produced near 90°. The inclusive cross section for single π^0 production at centre-of-mass energies 30.7, 53.1 and 62.4 GeV is presented. The data are found to be inconsistent with scaling of the form p/sub T/sup -n/ F(x/sub T/), where x/sub T/ = 2p/sub T//$\sqrt{s}$.

39825 **Production of photons associated with the psi by 217-GeV/c π^- mesons.** Kirk, T.B.W.; Raja, R.; Goodman, M.; Loomis, W.A.; Sessoms, A.L.; Tao, C.; Wilson, R.; Alverson, G.O.; Ascoli, G.; Bender, D.E.; Cooper, J.W.; Holloway, L.E.; Koester, L.J.; Kruse, U.E.; MacKay, W.W.; Sard, R.D.; Shupe, M.A.; Smith, E.B.; Davies, J.; Quirk, T.W.; Williams, W.S.C.; Thornton, R.K.; Milburn, R.H. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **42**: No. 10, 619-622(5 Mar 1979).

Dimuon production is studied in 217-GeV/c π^--hydrogen and π^--beryllium collisions with a lead-glass array to detect photons associated with the psi. The psi-γ mass spectrum shows a 2.6-standard-deviation excess of events above background at ~ 3.5 GeV. This excess, if attributed to the decay chi (~ 3.5) $\rightarrow$ psiγ, implies that 0.70 +- 0.28 of the psi's are produced via radiative decay of one of the chi states.

39826 **πi structure information from a jet experiment.** Dris, M.; Cormell, L.; Kononenko, W.; Robinson, B.; Selove, W.; Yost, B.; Gollon, P.J.; Kanofsky, A.; Corcoran, M.D.; Erwin, A.R.; Harvey, E.H.; Thompson, M. (University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev., D;* **19**: No. 5, 1361-1367(1 Mar 1979).

In a double-arm jet experiment, we have studied two-jet events in π^+ p and pp collisions. We analyze the data using a parton-scattering model and obtain a quark-plus-antiquark structure function for the pion.

39827 **Differential cross section for proton-proton bremsstrahlung at 1.38 GeV/c.** Nefkens, B.M.K.; Sander, O.R.; Sober, D.I.; Fearing, H.W. (Department of Physics, University of California, Los Angeles, California). *Phys. Rev., C;* **19**: No. 3, 877-895(Mar 1979).

We present the differential cross section for proton-proton bremsstrahlung at an incident beam momentum of 1.38 GeV/c (730 MeV). The measurements are made with an overconstrained detection system to reliably exclude all pp $\rightarrow$ ppπ^0 events. We have obtained differential cross sections at 16 photon angles at photon energies up to 200 MeV for protons scattered at 50° (lab). For each of the photon angles, $d^5\sigma/d\Omega$/sub p/$d\Omega$/sub γ/dE/sub γ/ decreases smoothly with increasing photon energy up to E/sub γ/(lab) $\simeq$ 80 MeV. Above this photon energy the cross sections rise again. Our results are compared with the soft photon approximation and the external emission dominance calculations. The soft pion approximation describes most spectra fairly well up to E/sub γ/ $\simeq$ 100 MeV and external emission dominance up to E/sub γ/ $\simeq$ 60 MeV (lab), but both predict cross sections which are too small at the highest photon energies.

39828 **Search for new massive particles.** Vidal, R.; Herb, S.W.; Lederman, L.M.; Snyder, H.D.; Yoh, J.K. (Columbia Univ., New York (USA)); Brown, C.N.; Innes, W.R.; Kephart, R.D.; Ueno, K.; Yamanouchi, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Phys. Lett., B;* **77**: No. 3, 344-346(14 Aug 1978).

The authors have searched for an almost stable, charged particle produced in 400 GeV proton-nucleus collisions. A total of 5 X 10^{10} light secondary particles were sampled in a secondary beam of 70 GeV/c momentum. If a 4.5 to 6.0 GeV mass particle is produced with a cross section comparable with the production cross

section of the upsilon then this experiment places an upper limit on the lifetime of such a particle of about 5×10^{-8}s.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 39454, 39822, 39853

39829 (COO—2197-63) **Pion-nucleon interaction and mesonic atoms. Progress report, 1 February 1978—31 January 1979.** Rebka, G.A. Jr.; Kunselman, R. (Wyoming Univ., Laramie (USA)). 1979. Contract EY-76-S-02-2197. 15p. Dep. NTIS, PC A02/MF A01.

During the year February 1, 1978 to January 31, 1979, the major activities under Task A were completion of the analysis of data taken in Experiment # 99, measurement of the cross section for completion of new $\pi^- p \rightarrow \pi^- \pi^+ n$, apparatus and software for Experiment # 337, measurement of the cross section for $\pi^- p \rightarrow \pi^- \pi^+ n$ at 200 and 229 MeV, taking data for Experiment # 337, continued preparation for Experiment # 309, and double charge exchange in the disintegration of ^{16}O, ^{40}Ca and ^{208}Pb, consideration of a possible collaboration for detection of protons from μ^- capture on nuclei and initiation of an association with physicists at Bates on measurements of (e,e'). The completed analysis of Experiment # 99 has left previous conclusions, that the integrated reaction cross section at the lowest energy is twice that interpolated from early measurements, intact. Experiment # 337 was mounted and the preliminary results for the reaction cross section at 229 MeV agree well with Experiment # 99. The more sophisticated instrumentation used in the latest measurements builds confidence in the validity of these results. An experiment on double charge exchange is being prepared and one on μ^- capture is being considered. A graduate student from the University of Wyoming has begun thesis research at Bates.

39830 (FERMILAB-CONF—78/37-THY, pp 105-128) **Lecture V. The new new particles.** Apr 1978.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

The most recent experimental data on upsilon resonances is described, and the new quarks are used in the treatment of them. The spectrum of charmonium, bound states in the Schroedinger equation, and the discovery of the upsilons in a historical account together with the experiments now in progress and some the theoretical speculations as to their structure. 12 references. (JFP)

39831 (LA-UR—79-653) **Kaon interactions with very light nuclei.** Gibson, B.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790347—1). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Low energy kaon interactions (both K and anti K) with very light nuclei are reviewed. Limitations upon present K-nucleus studies due to uncertainties in the K-N amplitudes are emphasized along with promising uses. A brief review of some of the many interesting aspects of anti K-nucleus scattering is given. Comparison of the limited anti K-d and anti K-^{4}He elastic data with theory is made. The anti Kd $\rightarrow \pi\Lambda p$ reaction is discussed including the possible ΣN virtual bound state. 49 references.

39832 (LA-UR—79-893) **Low energy PI super plus /sub p/ elastic scattering.** Frank, J.S.; Gram, P.A.M.; Nagle, D.E.; Redwine, R.P.; Browman, A.A.; Mischke, R.E.; Potter, J.M.; Yates-Williams, M.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790347—4). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Preliminary data are presented for the differential cross sections for $\pi^+ p$ and $\pi^- p$ elastic scattering at pion kinetic energies of 29.1 to 89.4 MeV. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

39833 (FERMILAB-CONF—78/37-THY, pp 61-80) **Lecture III. Production of charm.** Apr 1978.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

The production of charmed particles is discussed using simple arguments to understand the production cross sections in various situations in a survey of masses, names, decay modes, and production mechanisms. Thus an estimation can be made of the best place to find charmed particles and the places where it is more difficult to find them. Discussed are e^+e^- annihilation, peripheral production in hadron collisions, inclusive production in hadron collisions, production in (ν, anti ν)N reactions, and photoproduction of charm. 12 references. (JFP)

39834 (LBL—8936) **Role of deep inelastic processes in nuclear physics: experimental and theoretical aspects of deep inelastic reactions.** Moretto, L.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

The collective modes excited in deep-inelastic reactions and their natural hierarchy provided by their characteristic relaxation times is described. The relaxation of the mass asymmetry mode is discussed in terms of a diffusion process. Charge distributions and angular distributions as a function of Z calculated with this model are in good agreement with experimental data. This diffusion model also treats the transfer of energy and angular momentum in terms of particle transfer, and is successfully compared with experimental γ-ray multiplicities as a function of both Q-value and mass asymmetry. The angular momentum transfer is again considered in connection with the sequential fission of heavy, deep-inelastic fragments and the excitation of collective modes in the exit channel is considered. The role of the giant E1 mode in the equilibration of the neutron-to-proton ratio is discussed. 39 references.

39835 (UH—511-330-79) **Some remarks on grand unified models.** Pakvasa, S. (Wisconsin Univ., Madison (USA). Dept. of Physics). Jan 1979. Contract EY-76-C-03-0511. 5p. (CONF-781243—2). Dep. NTIS, PC A02/MF A01.

From Seminar on proton stability; Madison, WI, USA (8 Dec 1978).

A summary is given of previous talks on the grand unified models. The problems associated with the advantageous reduction of the number of coupling constants and a single gauge generating all interactions as well as proton stability are described. It is concluded that the grand unifying schemes are quite attractive, and proton decay a very likely consequence. Limits on this lifetime are welcome, although the precise rate of decay is difficult to predict. 16 references. (JFP)

39836 **Quark fragmentation: Some simple tests for quantum chromodynamics.** Suaya, R.; Townsend, J.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 5, 1414-1417(1 Mar 1979).

The effect of quark and gluon spin on the fragmentation of energetic quarks into hadrons is discussed. Particle ratios and polarization for wide-angle mesons and baryons are given. In particular, we find $\rho/\pi = 1$ with the ρ's longitudinally polarized. It is found that circularly polarized photon beams can serve as a source of polarized quarks and that Λ's produced in the photon-fragmentation region carry the same handedness as the photon.

39837 **Lattice-gauge-theory spectrum for broken SU(4).** Bergknoff, H. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **19**: No. 5, 1543-1556(1 Mar 1979).

The lattice gauge theory's Hamiltonian formulation is reviewed. We present a theory involving four quarks; a massless SU(2) doublet (u and d) and in addition, two massive quarks (c and s). Calculations of the theory's strong-coupling expansion are described, and mass ratios for six particles (psi,phi,Λ,Λ/sub c/,F,F*) are constructed. The results agree with the physical spectrum to 12% and exhibit sensible dependences on the input masses for the s and c quarks.

39838 **Quantum chromodynamics and the spin-dependent quark-antiquark forces.** Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev., D;* **19**: No. 5, 1566-1571(1 Mar 1979).

Recent results from quantum chromodynamics (QCD) are shown to be consistent with the generalized Breit-type phenomenological Hamiltonian previously proposed for the spin-dependent spectroscopy of quark-antiquark states. In particular, the concept of a short-distance and long-distance quark-gluon chromomagnetic moment, with different qualitative behavior for light and heavy quarks, is compatible with QCD. An induced axial-vector exchange, previously suggested by Feinberg and Sucher, also seems to be implied by the field-theoretic calculations.

39839 **Effective potential for heavy-quark—antiquark bound systems.** Levine, R.; Tomozawa, Y. (The Harrison M. Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Phys. Rev., D;* **19**: No. 5, 1572-1581(1 Mar 1979).

An analytic form for the quark-antiquark interaction potential is proposed based on the renormalization-group equation of quantum chromodynamics (QCD) and the confinement assumption. With validity of the nonrelativistic approximation assumed, energy spec-

tra, leptonic decay width, and E1 transition rates are computed. The results are compared with experimental data of psi and Y resonances. A possible spin-spin interaction of non-QCD origin is then discussed.

39840 Phase transitions in the Abelian Higgs model. Einhorn, M.B.; Savit, R. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). *Phys. Rev., D;* **19**: No. 4, 1198-1213(15 Feb 1979).

A lattice version of the Abelian Higgs model is studied in arbitrary Euclidean dimension. Two different representations of the theory, one in terms of the Higgs and gauge fields and the other in terms of the topological excitations, are used to understand what phases exist for the system. In addition to limiting cases there is, in two dimensions, a plasma phase of vortex excitations. The vortices (instantons) in this phase cause confinement (in the sense of Wilson) of fractional, but not integer, charges. In three and more dimensions, there is a plasma phase similar to the one in two dimensions as well as another phase which does not confine any charge. We argue that the confinement due to topological excitations in the plasma phase has the same physical basis as the usual large-coupling-constant (high temperature) confinement of the lattice gauge theory. Effects of a background field in two dimensions are also described.

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 39856, 39857

39841 (LA-UR—79-357) **Radiation reaction in nonrelativistic quantum theory.** Sharp, D.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 25p. (CONF-790428—1). Dep. NTIS, PC A02/MF A01.

From Symposium on the foundations of radiation theory and quantum electrodynamics; Boulder, CO, USA (28 Apr 1979).

Some recent work is reviewed on the quantum theory of radiation reaction. The starting point is the Heisenberg operator equation of motion for a nonrelativistic point electron coupled to the quantized electromagnetic field. It is shown that this equation, in contrast to its classical counterpart, leads to a finite value for the electrostatic self-energy of a point electron and, for values of the fine structure constant α approximately less than 1, admits neither runaway behavior nor noncausal motion. Furthermore, the correspondence limit of the solution to the quantum mechanical equation of motion agrees with that of the Lorentz—Dirac theory in the classical regime, but without the imposition of additional conditions and with no possibility of observable noncausality. Thus, a consistent picture of a classical point electron emerges in the correspondence limit of the quantum mechanical theory. 17 references.

39842 Production of jets and single particles at large transverse momentum in photon-photon collisions. Brodsky, S.J.; DeGrand, T.; Gunion, J.; Weis, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 5, 1418-1443(1 Mar 1979).

Photon-photon collisions will be a copious source of jets and single particles produced with large transverse momentum in e^+e^- storage rings. These jets and single particles have topological properties which allow them to be easily distinguished from e^+e^- annihilation events. They arise from several sources: (a) quark exchange in $\gamma\gamma \to$ qq-bar, (b) quantum-chromodynamics (QCD) induced processes such as $\gamma_l \to$ qq-bar, with qq scattering via vector-gluon exchange, and (c) differential cross sections proportional to p/sub T/$^{-6}$ and p/sub T/$^{-8}$ at fixed x/sub T/ = 2p/sub T//$\sqrt{}$s-bar and fixed θ/sub c.m./ characteristic of the constituent-interchange model (CIM) picture. In particular, we predict Edσ/d^{3}p ($e^+e^- \to e^+e^-$ + jet + X) ~ (1 - x/sub T/)^{2}p/sub T/$^{-6}$ nb GeV^4 for p/sub T/ > 2 GeV/c, characteristic of the CIM subprocess $\gamma q \to \pi q$. Remarkably, the jet-trigger cross sections Edσ/d^{3}p ($\gamma\gamma \to$ jet + X) turn out to be asymptotically scale-free and independent of α/sub c/(p/sub T/^{2}) when perturbative QCD contributions to all orders are included.

39843 Lepton-width suppression of vector-meson decays. Celmaster, W. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 5, 1517-1521(1 Mar 1979).

Quantum-chromodynamics radiative corrections to the vector-meson lepton width are discussed. These may modify the zeroth-order equation of Van Royen and Weisskopf, thereby leading to a significant suppression, by about a factor of 2, of the calculated value of Γ. Consequences for phenomenology are examined. In particular, a prediction is made for the width of Y, as well as for widths of heavier mesons.

39844 Charmed-baryon production in electron-positron annihilation. Mikaelian, K.O.; Oakes, R.J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **19**: No. 5, 1613-1615(1 Mar 1979).

A plausible model for the production of the lowest-lying charmed-baryon pairs in electron-positron annihilation is shown to be in good quantitative agreement with the recent data on the inclusive antiproton yield near the charmed baryon threshold. At higher energies well above threshold the contribution of the exclusive two-body processes which we have considered falls below the data indicating a significant antiproton yield from other channels. The inclusive production of Λ's and of charged Σ's are also briefly discussed.

39845 Corrections to the sixth-order anomalous magnetic moment of the muon. Laursen, M.; Samuel, M.A. (Quantum Theoretical Research Group, Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74074). *Phys. Rev., D;* **19**: No. 4, 1281-1282(15 Feb 1979).

The contribution to the sixth-order muon anomaly from fourth-order electron vacuum polarization is determined analytically to order m/sub e//m/sub μ/. The result including the contribution from graphs m/sub e//m/sub μ/. The result including the contribution from graphs containing two second-order lepton vacuum polarization subgraphs is $(\alpha/\pi)^3\{$ (2/9)ln^2(m/sub μ//m/sub e/) + zeta (3)/2 + $2\pi^3/27$ + 5/27 + [$383\pi^2/135$ - $16\pi^2$ln(2)/9 - $13\pi^2/18$]m/sub e//m/sub μ/$\}$.

39846 Anomalous e^+e^- and $\mu^+\mu^-$ events produced in e^+e^- annihilation. Heile, F.B.; Perl, M.L.; Abrams, G.S.; Alam, M.S.; Boyarski, A.M.; Breidenbach, M.; Dorfan, J.; Feldman, G.J.; Goldhaber, G.; Hanson, G. (Stanford Linear Accelerator Center, CA (USA)). *Nucl. Phys., B;* **138**: No. 2, 189-217(12 Jun 1978).

The authors have observed events of the form $e^+ + e^- \to e^+ + e^-$ and $e^+ + e^- \to \mu^+ + \mu^-$ in which there are no other detected particles and there is substantial missing energy; and which cannot be explained by conventional electromagnetic interactions. It is shown that these events can be explained as the decay products from the pair production, $e^+ + e^- \to$ tau$^+$ + tau$^-$, of a new charged lepton, tau^{+-}, of mass approximately 1800 MeV/c^2. Some properties of these events are presented. In particular, this production cross section is inconsistent with the tau being an electron-related paralepton.

39847 Determination of the axial vector form factor in the radiative decay of the pion. Stetz, A.; Carroll, J.; Ortendahl, D.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Igo, G.; Chirapatpimol, N.; Nasser, M.A. (California Univ., Los Angeles (USA). Dept. of Physics). *Nucl. Phys., B;* **138**: No. 2, 285-318(12 Jun 1978).

The branching ratio for the decay $\pi \to e\gamma\gamma$ has been measured in a counter experiment in which the e^+ was detected in a magnetic spectrometer and the γ-ray in a lead-glass hodoscope. The number of observed events is 226.2 +- 22.4. The branching ratio into that part of phase space with electron momentum above 56 MeV/c and the electron-photon opening angle greater than 132^0 is found to be (5.6 +- 0.7) X 10^{-8}. From the measured branching ratio the authors determine γ, the ratio of the axial to vector form factors. The vector form factor is computed using CVC and the π^0 lifetime. For Tsub(π^0) = 0.828 X 10^{-16} s, γ = 0.44 +- 0.12 or γ = -2.36 +- 0.12 is obtained. The measurement is compared with several theoretical predictions.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 39843, 39846

39848 Model-independent determination of hadronic neutral-current couplings. Claudson, M.; Paschos, E.A.; Strait, J.; Sulak, L.R. (Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., D;* **19**: No. 5, 1373-1381(1 Mar 1979).

Completion of a second generation of experiments on neutrino-induced neutral-current reactions allows a more discriminating study of neutral-current couplings to hadrons. To minimize the sensitivity to model-dependent analyses of inclusive and exclusive pion data, we base our work on measurements of deep-inelastic and elastic reactions alone. Within the regions allowed by the deep-inelastic data for scattering on isoscalar targets, the coupling constants are fit to the q^2 dependence of the neutrino-proton elastic scattering data. This procedure initially yields two solutions for the couplings. One of these, at θ/sub L/ = 55^0 and θ/sub R/ = 205^0, is predominantly isoscalar and therefore is ruled out by only qualitative consideration of exclusive pion data. The other solution at θ/sub D/ = 140^0 and and θ/sub R/ = 330^0, is thus a unique determination of the hadronic neutral-current couplings. It coincides with solution A obtained in earlier work, and is insensitive to variations of M/sub A/ within 2 standard deviations of the world average. When constrained to the coupling constants required by the Weinberg-Salam model, the fit agrees with the data to within 1 standard deviation.

39849 Hadronic fragmentation initiated by pointlike probes. DeGrand, T.A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 5, 1398-1413(1 Mar 1979).

Isotopic ratios of fast mesons produced in the target-fragmentation region in reactions initiated by pointlike probes should resemble those seen in ordinary hadronic reactions when the probe removes sea partons from the target but should show dramatic changes once the probe knocks out valence partons. We use simple parton-fusion models to predict the shapes and magnitudes of inclusive meson spectra (π^+,π^-,K^+,K^-) in the target-fragmentation region of μp, νp, and nu-barp semi-inclusive scattering and in the inclusive production of mesons in association with a massive lepton pair: pp $\rightarrow$ $\mu^+\mu^-$ MX or pp-bar $\rightarrow$ $\mu^+\mu^-$ MX. Our predictions are in agreement with the limited existing data on these reactions and indicate areas where experiments may shed light on the correlated distribution of several partons in the nucleon.

39850 **Multilepton final states and the weak interactions of the fifth quark.** Quigg, C.; Rosner, J.L. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., D;* **19**: No. 5, 1532-1542(1 Mar 1979).

We summarize the evidence for the properties of a fifth quark, denoted as b, which is a constituent of Y (9.4 GeV/c^2). We show how an analysis of the lepton content of final states arising from unbound (bb-bar) production can yield the relative strengths of the b $\rightarrow$ u + W^- and b $\rightarrow$ c + W^- weak-current transitions.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 39872

39851 (COO—1545-250) **Resonant production of high-transverse-momentum back-to-back gluon jets in pp collisions.** Aubrecht, G.J. II; Nandi, S.; Wada, W.W. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1978. Contract EY-76-C-02-1545. 11p. Dep. NTIS, PC A02/MF A01.

The calorimetric study of two-gluon jets arising from inclusive production of 0^{-+}, 0^{++}, and 2^{++} b anti b states in hadron—hadron collisions was proposed. Cross sections of $\approx 0.2 \times 10^{-33}$ cm^2 ($\approx 3 \times 10^{-33}$ cm^2) are predicted for pp collisions at $\sqrt{s} = 27$ GeV (60 GeV). Also calculated were the transverse momentum and angular distributions of the jets. 14 references.

39852 (DOE/ER/70004—207) **Parton recombination model.** Hwa, R.C. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.; Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Aug 1978. Contract EY-76-S-06-2230-004. 16p. (RLO—223/T4-207; CONF-780788—3). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on high energy multiparticle dynamics; Tabor, Czechoslovakia (2 Jul 1978).

Low P/sub T/ meson production in hadronic collisions is described in the framework of the parton model. The recombination of quark and antiquark is suggested as the dominant mechanism in the large x region. Phenomenological evidences for the mechanism are given. The application to meson initiated reactions yields the quark distribution in mesons. 21 references.

39853 (FERMILAB-CONF—78/37-THY) **Lectures on charmed particles.** Quigg, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1978. Contract EY-76-C-02-3000. 133p. (CONF-7709177—1). Dep. NTIS, PC A07/MF A01.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

Separate abstracts were prepared for the five lectures presented. (JFP)

39854 (FERMILAB-CONF—78/37-THY, pp 1-28) **Lecture I. Introduction to charm.** Apr 1978.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

Lectures are given on some manifestations of charm and some characteristics of the charmed particle. Various points of view in a cultural orientation, leptons, reasons for a belief in quarks, gauge theories of weak and electromagnetic and strong interactions, and lastly the viewpoint that there is not a systhesis at hand, but instead chaos are treated. 6 references. (JFP)

39855 (LBL—7574, pp 15-30) **Expectations for ultra-high energy interactions.** Feynman, R.P. (California Inst. of Tech., Pasadena). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

Strong interactions at ultra-high energies are discussed with emphasis on the hadrons produced in high energy collisions. Evidence is considered that quantum chromodynamics might be the right theory, and also some estimates are given of quantum chromodynamics asymptotic-freedom phenomena, the work under discussion being very preliminary. 6 references. (JFP)

39856 (SLAC-PUB—2298) **Quantum chromodynamics and the dynamics of hadrons.** Brodsky, S.J. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 58p. Dep. NTIS, PC A04/MF A01.

The application of perturbative quantum chromodynamics to the dynamics of hadrons at short distance is reviewed, with particular emphasis on the role of the hadronic bound state. A number of new applications are discussed, including the modification to QCD scaling violations in structure functions due to hadronic binding; a discussion of coherence and binding corrections to the gluon and sea-quark distributions; QCD radiative corrections to dimensional counting rules for exclusive processes and hadronic form factors at large momentum transfer; generalized counting rules for inclusive processes; the special role of photon-induced reactions in QCD, especially applications to jet production in photon-photon collisions, and photon production at large transverse momentum. Also presented is a short review of the central problems in large P/sub T/ hadronic reactions and the distinguishing characteristics of gluon and quark jets. 163 references.

39857 **Quark analysis of multibaryonic systems.** Matveev, V.A.; Sorba, P. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuovo Cim., A;* **45**: No. 2, 257-279(21 May 1978).

Properties of the 3n-quark systems in the spherical-cavity approximation of the MIT bag model are considered. Results concerning the kinematics-colour restrictions, baryon composition- as well as the dynamics-mass formulae, magnetic moments, gluon corrections-of such states are obtained via a group-theoretical treatment. The appearance of "hidden colour" baryonic mixtures in multibaryonic states is emphasized, and the role of the quark-gluon interaction illustrated.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 39849, 39851

39858 (DOE/ER/70004—218) **Resolution of the eta' $\rightarrow$ eta $\pi\pi$ puzzle.** Deshpande, N.G.; Truong, T.N. (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract EY-76-S-06-2230-004. 7p. (RLO—2230-T4-218). Dep. NTIS, PC A02/MF A01.

Current algebra calculation with symmetry breaking arising from quark mass terms is shown not to be inconsistent with the experimental features of eta' $\rightarrow$ eta $\pi\pi$ decay. 9 references.

39859 (FERMILAB-CONF—78/37-THY, pp 29-60) **Lecture II. Charmed particle spectroscopy.** Apr 1978.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

The discussion of charmed particle spectroscopy covers the particle properties and interrelations from a charmed quark composition point of view including SU(4)-symmetry generalities, mesons, baryons, charmed particle masses, and decays of charmed particles. 6 references. (JFP)

39860 (FERMILAB-CONF—78/37-THY, pp 80-104) **Lecture IV. Experimental status of charm.** Apr 1978.

From 11. international school for young scientistis on high energy phisics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

Experimental status of charm particles is described in a review of their structure and properties. The D meson decay phenomena are mainly discussed. 20 references. (JFP)

39861 (FERMILAB-Conf—78/73-THY) **Quasinuclear colored quark model for hadrons.** Lipkin, H.J. (Fermi National Accelerator Lab., Batavia, IL (USA); Argonne National Lab., IL (USA); Weizmann Inst. of Science, Rehovoth (Israel)). Sep 1978. Contract EY-76-C-02-3000. 67p. Dep. NTIS, PC A04/MF A01.

Lectures are presented in which a quasinuclear constituent quark model in which constituent quarks are assumed to be made of constituent interacting with a two-body color-exchange logarithmic potential is considered. The color degree of freedom is discussed in detail. Some properties of the logarithmic potential and the definition of the quasinuclear model and its validity, and a comparison of some of its predictions with experiment are described. 31 references. (JFP)

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 39835, 39859, 39861

39862 Amplitude analysis of the reaction $\pi^+ p \rightarrow rho^0 \Delta^{++}$ at 3.75 GeV/c. Gelfand, N.; Dagan, S.; Lissauer, D.; Oren, Y. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Abrams, G.S.; Barnham, K.W.J.; Daugeras, B.Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., B;* **138**: No. 3, 365-386(19 Jun 1978).

The joint decay distribution statistical tensors for the reaction $\pi^+ p \rightarrow rho^0 \Delta^{++}$ have been measured as a function of t at 3.75 GeV/c. From these data the amplitude components of the reaction were extracted using both t-independent and t-dependent methods. The magnitudes of the amplitudes obtained from both methods are found to agree and appear to be insensitive to the fitting methods. The phases are not well determined in the t-independent method. A comparison is made with a similar analysis done at 7.1 GeV/c.

39863 (LA-UR—79-361) Mechanisms of proton stability and decay in unified models. Slansky, R. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 16p. (CONF-781243—1). Dep. NTIS, PC A02/MF A01.

From Seminar on proton stability; Madison, WI, USA (8 Dec 1978).

The issue of proton stability is reviewed in the context of Yang—Mills theories that unify electromagnetic, weak, and strong interactions with a simple Lie group G. It is possible in these theories to make the proton exactly stable or to give it a finite but long lifetime; mechanisms for both possibilities are described. 18 references.

39864 ΛK and ΣK systems observed in π^+ interactions at 10.3 GeV/c. Goddard, M.C.; Key, A.W. (Toronto Univ., Ontario (Canada). Dept. of Physics); Gordon, H.A.; Lai, K.W. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Phys., B;* **138**: No. 2, 285-318(12 Jun 1978).

Broad threshold enhancements are observed in the ΛK and ΣK mass spectra in the $\Lambda K2\pi$, $\Lambda K3\pi$, $\Lambda K4\pi$, $\Sigma K3\pi$, $\Sigma K4\pi$ final states. The enhancements are shown to be consistent with peripheral phase space. In the $\Sigma K2\pi$ channels the ΣK mass distribution shows evidence for a high mass Δ (M = 1870 +- 20 MeV, GAMMA = 114 +- 35 MeV).

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 39846, 39934

39865 (LBL—8561) Large fragment production calculations in relativistic heavy-ion reactions. Seixas de Oliveira, L.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 155p. Dep. NTIS, PC A08/MF A01.

Thesis.

The abrasion-ablation model is briefly described and then used to calculate cross sections for production of large fragments resulting from target or projectile fragmentation in high-energy heavy-ion collisions. The number of nucleons removed from the colliding nuclei in the abrasion stage and the excitation energy of the remaining fragments (primary products) are calculated with the geometrical picture of two different models: the fireball and the firestreak models. The charge-to-mass dispersion of the primary products is calculated using either a model which assumes no correlations between proton and neutron positions inside the nucleus (hypergeometric distribution) or a model based upon the zero-point oscillations of the giant dipole resonance (NUC-GDR). Standard Weisskopf—Ewing statistical evaporation calculations are used to calculate final product distributions. Results of the pure abrasion-ablation model are compared with a variety of experimental data. The comparisons show the insufficiency of the extra-surface energy term used in the abrasion calculations. A frictional spectator interaction (FSI) is introduced which increases the average excitation energy of the primary products, and improves the results considerably in most cases. Agreements and discrepancies of the results calculated with the different theoretical assumptions and the experimental data are studied. Of particular relevance is the possibility of observing nuclear ground-state correlations.Results of the recently completed experiment of fragmentation of 213 Mev/A ^{40}Ar projectiles are studied and shown not to be capable of answering that question unambiguously. But predictions for the upcoming ^{48}Ca fragmentation experiment clearly show the possibility of observing correlation effects. 78 references.

39866 Rescattering corrections to spin-dependent proton-deuteron total cross sections. Sorensen, C. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 5, 1444-1450(1 Mar 1979).

Formulas for rescattering corrections to spin-dependent proton-deuteron total cross sections are derived within the framework of the Glauber model. The standard "Glauber correction formula" is shown to generalize in a simple way to differences of spin-dependent cross sections. Present knowledge of nucleon-nucleon scattering amplitudes is used to evaluate the rescattering corrections.

39867 Quantum-chromodynamic predictions for inclusive spin-spin asymmetries at large transverse momentum. Babcock, J.; Monsay, E.; Sivers, D. (Argonne National Laboratory, High Energy Physics Division, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 5, 1483-1502(1 Mar 1979).

We discuss predictions for the asymmetry A/sub L/L in the inclusive production at large p/sub T/ of charged and neutral pions by longitudinally polarized protons. We work in the framework of a hard-scattering model based on perturbative quantum chromodynamics. Various assumptions for the distribution of the proton's spin among its constituents: quarks, ocean antiquarks, and gluons: and the effects of scaling violations on the parton distributions are considered.

39868 Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target. Hidaka, K.; Monsay, E.; Sivers, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 5, 1503-1508(1 Mar 1979).

We apply a hard-scattering model based on quantum-chromodynamic perturbation theory to the production of hadrons at large transverse momentum by transversely polarized beam and target protons. We find that, at large x/sub T/ = 2p/sub T//$\sqrt{s}$-bar, the spin-spin asymmetry A/sub N/N for the case of transversely polarized protons is significantly smaller than the corresponding asymmetry A/sub L/L for longitudinally polarized protons. This situation is due to the relatively smaller size of both the quark-quark scattering asymmetry and the spin-dependent distribution functions for quarks in the transversely polarized proton.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

39869 Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model. Kitazoe, T.; Mainland, G.B.; Tanaka, K. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **19**: No. 5, 1601-1604(1 Mar 1979).

We determine the vacuum expectation values of the Higgs scalars within the framework of a six-quark SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model after the imposition of discrete symmetries that are necessary in order to express the Cabibbo angle in terms of quark mass ratios and phases of the vacuum expectation values. We find both real and complex solutions for the vacuum expectation values depending on the relative values of the parameters in the Higgs potential.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

39870 Parity non-conservation in inelastic electron scattering. Prescott, C.Y.; Atwood, W.B.; Cottrell, R.L.A.; DeStaebler, H.; Garwin, E.L.; Gonidec, A.; Miller, R.H.; Rochester, L.S.; Sato, T.; Sherden, D.J. (Stanford Linear Accelerator Center, CA (USA)). *Phys. Lett., B;* **77**: No. 3, 347-352(14 Aug 1978).

The authors have measured parity violating asymmetries in the inelastic scattering of longitudinally polarized electrons from deuterium and hydrogen. For deuterium near $Q^2 = 1.6(GeV/c)^2$ the asymmetry is $(-9.5X10^{-5})Q^2$ with statistical and systematic uncertainties each about 10%.

39871 Comment on the magnetic moments of baryons in the broken-SU(6) -symmetry model. Tomozawa, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Phys. Rev., D;* **19**: No. 5, 1626-1629(1 Mar 1979).

It is pointed out that the consideration of the physical mass in the computation of the baryon magnetic moments in broken SU(6) symmetry allows us to choose a value of the quark mass ratio different from that chosen by De Rujula, Georgi, and Glashow and leads to a prediction significantly different from their results. Precision measurements by hyperon beams, which are planned at the Fermilab and at CERN in the near future, could differentiate between the two sets of predictions.

FIELD THEORY

REFER ALSO TO CITATION(S) 39855, 39856

39872 (UH—511-329-79) **Asymptotic freedom without guilt.** Ma, E. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jan 1979. Contract EY-76-C-03-0511. 9p. Dep. NTIS, PC A02/MF A01.

The notion of asymptotic freedom in quantum chromodynamics is explained on general physical grounds, without invoking the formal arguments of renormalizable quantum field theory. The related concept of quark confinement is also discussed along the same line. 5 references.

39873 **Results on nucleon structure functions in quantum chromodynamics.** Martin, F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 5, 1382-1397(1 Mar 1979).

Gluon bremsstrahlung processes inside the nucleon are investigated using the standard renormalization-group analysis. A new method of inverting the moments is applied which leads to analytic results for the parton distributions near $x = 1$ and $x = 0$. The nucleon is considered as a bound state of three quarks subsequently "renormalized" by gluon bremsstrahlung and quark-antiquark pair production. An "unrenormalized" valance quark distribution peaked at $x = 1/3$, with a width related to the nucleon radius, leads to good agreement with deep-inelastic data. However, the gluon distribution obtained seems too steep near $x = 0$.

39874 **Vacuum-polarization-corrected long-distance static quark-antiquark potential.** Poggio, E.C.; Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). *Phys. Rev., D;* **19**: No. 5, 1557-1565(1 Mar 1979).

Vacuum polarization at long distances for confined heavy-quark—antiquark (QQ-bar) pairs is considered. It is argued that the static confining potential cannot grow faster than a linear potential at large distances. The vacuum-polarization-corrected potential is a flavor-independent potential which allows interpolation between charmonium, Y and other QQ-bar systems.

39875 **Quark confinement in unusual environments.** Fischler, W.; Kogut, J.; Susskind, L. (Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **19**: No. 4, 1188-1197(15 Feb 1979).

We consider the properties of one-dimensional gauge field theories at finite temperatures and densities. The massive Schwinger model in the presence of a uniform charge background is shown to form a Wigner crystal which Debye screens charged impurities. The two-species Schwinger model with oppositely charged fermions is studied at finite baryon density. This system does not undergo a phase transition as the density is increased, but becomes progressively more polarizable until at infinite density Debye screening occurs. Finally we consider the massive Schwinger model at nonzero temperature and show that Debye screening occurs at infinite temperature. We speculate that in three dimensions this last transition occurs at finite temperature.

39876 **Higher-order instanton effects.** Levine, H.; Yaffe, L.G. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **19**: No. 4, 1225-1242(15 Feb 1979).

We present a formalism for calculating higher-order instanton effects based on a systematic expansion of the functional integrals about multiple instanton-anti-instanton configurations. We consider how various correlation functions may be constructed from the determinants and propagators in a background multiple-instanton field. A multiple-scattering formalism is then developed in order to express these determinants and propagators for a multi-instanton field in terms of the basic single-instanton quantities. The introduction of an improved gluon propagator based on a different choice of zero-mode constraints is required in order to justify the multiple-scattering formalism. As examples of this approach, we consider instanton interactions, which appear as corrections to the dilute-gas approximation for the instanton density, and the first-order quantum contributions to the static quark potential.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 39378

39877 (DOE/ER—0020) **Summaries of FY 1978 research in nuclear physics.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Dec 1978. 172p. Dep. NTIS, PC A08/MF A01.

Programs funded in Fiscal Year 1978 by the Division of Nuclear Physics Office of High Energy and Nuclear Physics, U.S. Department of Energy are briefly summarized. Long-range goals and major objectives of nuclear physics are stated. Research projects are listed alphabetically by institution under the following headings: medium-energy nuclear physics--research; medium-energy nuclear physics--operations; heavy-ion nuclear physics--research; heavy-ion nuclear physics--operations; and nuclear theory. (RWR)

39878 (LA—7663-MS) **Summary documentation of LASL nuclear data evaluations for ENDF/B-V.** Young, P.G. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jan 1979. Contract W-7405-ENG-36. 148p. Dep. NTIS, PC A07/MF A01.

Summaries are presented of nuclear data evaluations performed at Los Alamos Scientific Laboratory (LASL) that will comprise part of Version V of the Evaluated Nuclear Data File, ENDF/B. A total of 18 general purpose evaluations of neutron-induced data are summarized, together with 6 summaries directed specifically at covariance data evaluations. The general purpose evaluation summaries cover the following isotopes: $^{1-3}$H, ^{3} ^{4}He, ^{6} ^{7}Li, ^{10}B, ^{14} ^{15}N, ^{16}O, ^{27}Al, ^{182} ^{183} ^{184} ^{186}W, ^{233}U, and ^{242}Pu. The covariance data summaries are given for ^{1}H, ^{6}Li, ^{10}B, ^{14}N, ^{16}O, and ^{27}Al. 28 figures.

39879 (LA—7722-PR) **Applied nuclear data research and development. Progress report, October 1—December 31, 1978.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 36p. Dep. NTIS, PC A03/MF A01.

The activities of the Los Alamos Nuclear Data Group during this period fall into three major categories: theory and evaluation of nuclear cross sections; nuclear cross-section processing; and fission products and actinides: yields, yield theory, decay data, depletion, and buildup. Individual papers with significant amounts of data are abstracted and indexed separately. (RWR)

39880 **Third international school on neutron physics.** Dubna, USSR; Joint Inst. for Nuclear Research (1978). 512p. (In Russian and English). (CONF-780463—).

From 3. international school on neutron physics; Alushta, USSR (19 Apr 1978).

Twenty-four papers are presented. A separate abstract was prepared for one of these, and another has already been cited in ERA; it can be found by referring to the entry CONF-780463— in the Report Number Index. It is assumed that the remaining papers will be entered into the data base from the Atomindex tape. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39831, 39870

39881 (LA—7663-MS, pp 4-14) **Summary documentation for ^{1}H.** Stewart, L.; LaBauve, R.J.; Young, P.G. (Los Alamos Scientific Lab., NM). Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

The ^{1}H evaluation for ENDF/B-V (MAT 1301) is basically the same as the Version IV evaluation. Changes include the addition of correlated error data in MF = 33 and different interpolation rules for MT = 1 and 2 in MF = 3. The evaluation covers the energy range 10^{-5} eV to 20 MeV, and documentation is provided in LA-4574 (1971) and LA-6518-MS (1976). 5 figures.

39882 (LA—7663-MS, pp 21-25) **Summary documentation for ^{3}He.** Stewart, L. (Los Alamos Scientific Lab., NM). Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

The ^{3}He evaluation for ENDF/B-V (MAT 1146) was carried over intact from Version IV. The evaluated data cover the energy range 10^{-5} eV to 20 MeV, and documentation for the standards portion of the data is given in LA-6518-MS (1976). 3 figures.

39883 (LA—7663-MS, pp 26-39) **Summary documentation for ^{4}He.** Hale, G.M.; Nisley, R.A.; Young, P.G. (Los Alamos Scientific Lab., NM). Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

The ENDF/B-V evaluation for ^{4}He (MAT 1270) is the same as Version IV except for minor format changes. The evaluation covers the energy range 10^{-5} eV to 20 MeV and is based at all energies on an extensive R-matrix analysis, which is described in NEANDC (J) 38L. By making use of the charge symmetry of nuclear forces, p—^{4}He data were included in the analysis along with the available n—^{4}He measurements of cross sections, angular distributions, and polarizations. Because of the extent of the data base used and the careful analysis it was given, the cross sections and

angular distributions are thought to be accurate to about +- 2% at all energies. As all gamma-ray production cross sections are essentially zero for ^{4}He, gamma ray files (MF=12-16) are deliberately excluded from the evaluation. 13 figures.

39884 (LA—7722-PR, pp 1-10) **Theory and evaluation of nuclear cross sections: fusion reactions.** Hale, G. Mar 1979.

In Applied nuclear data research and development. Progress report, October 1—December 31, 1978.

Results of R-matrix fits to measurements of the T(t,2n)^{4}He cross section from 0.02 to 2.5 MeV are shown. A J/sup π/ assignment of 0^+ to a level around 2 MeV (corresponding to a level at 13.6 MeV in ^{6}He) is tentatively suggested. The energy dependence of ^{6}Li(p,^{3}He) and T(p,n)^{3}He reaction rates is described. 1 figure. (RWR)

39885 (LA-UR—79-638) **Pion single charge exchange.** Cooper, M.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790347—5). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

The LAMPF π^0 spectrometer is described, and the first results of pion single charge exchange to discrete nuclear states are discussed. Angular distribution information was obtained in ^{3}He, and 0^0 excitation functions for the isobaric analog state were observed in targets throughout the periodic table. 8 references.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

39886 **Origin of gross structure in ^{12}C + ^{12}C and ^{16}O + ^{16}O inelastic scattering.** Phillips, R.L.; Erb, K.A.; Bromley, D.A.; Weneser, J. (A. W. Wright Nuclear Structure Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). *Phys. Rev. Lett.;* **42**: No. 9, 566-570(26 Feb 1979).

A nonresonant diffraction-model calculation is fornd adequate to describe the gross-structure behavior thus far observed in the ^{12}C + ^{12}C and ^{16}O + ^{16}O inelastic scattering excitation functions.

NUCLEAR REACTIONS AND SCATTERING

39887 (LBL—8463) **Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A.** Lemaire, M.C.; Nagamiya, S.; Chamberlain, O.; Shapiro, G.; Schnetzer, S.; Steiner, H.; Tanihata, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 185p. Dep. NTIS, PC A09/MF A01.

A data compilation expressed in tables and graphs is presented for the cross sections for particle production in certain heavy ion reactions at 800 MeV/A. (JFP)

39888 **Isobars and the medium-energy (γ,p) reaction.** Londergan, J.T.; Nixon, G.D. (Department of Physics, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., C;* **19**: No. 3, 998-1024(Mar 1979).

Recently, precise experimental measurements have been obtained for the reaction ^{16}O(γ,p)^{15}N for photon energies 50—350 MeV. For photon energies greater than 100 MeV, isobar photoproduction is expected to provide an important part of the (γ,p$_0$) reaction. We evaluate the isobar contribution to the (γ,p) reaction, and we add this amplitude to a term which corresponds to direct knockout of the proton by the photon. We compare our results in detail with the experimental data from Glasgow and Bates on ^{16}O. Our calculation uses coupling constants and nuclear wave functions determined from independent experiments, and we neglect the isobar-nucleus interaction. Agreement with the experimental data is quite reasonable, and isobar photoproduction provides a very large contribution to the nuclear photoeffect in ^{16}O, for photon energies above about 100 MeV. We consider the effects of various corrections to our formalism, such as the effect of distortion of the outgoing nucleon by the nuclear force, center of mass corrections, and the inclusion of rho mesons in addition to pions at the isobar decay vertex. None of these corrections alters the qualitative features of the isobar amplitude and its importance in the nuclear photoeffect at medium energies.

39889 **Effect of short-range correlations in the second order pion-carbon optical potential.** Garcilazo, H. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Phys., A;* **302**: No. 2, 493-510(19 Jun 1978).

The author constructs a second order pion-carbon optical potential in momentum space and uses it to calculate cross sections for energies between 40 and 280 MeV. It is shown that the cross sections calculated with this potential depend very strongly on the range of the pion-nucleon interaction for energies below the 3,3 resonance. For energies above the 3,3 resonance the main effect of the second order optical potential is to raise the cross sections at large angles by factors of between 2 and 3 independently of the pion-nucleon range. Some approximate formulas are derived for the second order term of the optical potential and their range of validity is determined. The sensitivity of the results to the use of different relativistic propagators for the pion is also studied.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

39890 **Inelastic electron scattering from ^{14}N at 180°.** Ensslin, N.; Fagg, L.W.; Lindgren, R.A.; Bendel, W.L.; Jones, E.C. Jr. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Phys. Rev., C;* **19**: No. 3, 569-573(Mar 1979).

Inelastic electron scattering from ^{14}N at 180° has been studied at incident energies of 40.6, 50.6, and 60.2 MeV. Transitions to levels at 2.31, 9.17, and 10.43 MeV excitation energy were observed to be predominantly M1. The transition to the level at 16.11 MeV probably contains some M2 strength, and transitions to levels at 12.54, 13.27, and 13.76 appear to exhibit some M1 strength. Data on the 2.313 MeV transition, combined with earlier experiments, brings the observed reduced transition width into agreement with resonance fluorescence techniques. Transition widths for the other levels with reasonably certain multipolarities are also given.

39891 **Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ ≃ 14.3 and 25.2 MeV.** Lumpkin, A.H.; Harwood, L.H.; Fox, J.D.; Kemper, K.W. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). *Phys. Rev., C;* **19**: No. 3, 785-789(Mar 1979).

The enhanced yields of high spin states populated in the p and d exit channels for ^{12}C + ^{12}C reactions are utilized for particle-α coincidence measurements at E/sub c.m./ ≃ 14.3 and 25.2 MeV. The (^{12}C,pγ) results at E/sub c.m./ ≃ 14.3 MeV support the $15/2^+$ assignment to the E/sub x/ = 9.80 MeV state. The (^{12}C,dγ) results at E/sub c.m./ ≃ 25.2 MeV show an enhanced 9.77 MeV (9^+) state to have a strong γ-ray branch to the E/sub x/ = 4.52 MeV (7^+) state.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39378, 39831, 39943

39892 (LA—7663-MS, pp 40-48) **Summary documentation for ^{6}Li.** Hale, G.M.; Stewart, L.; Young, P.G. (Los Alamos Scientific Lab., NM). Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

The previous evaluation for ^{6}Li was extensively revised for Version V of ENDF/B (MAT 1303). All major cross-section files except radiative capture were updated. A new R-matrix analysis including recent experimental results was performed up to a neutron energy of 1 MeV, which includes the standards region for the ^{6}Li(n,t)^{4}He reaction. Extensive revisions were made in the MeV region to include a more precise representation of the (n,n'd) reaction. In the new representation, the (n,n'd) cross section is grouped into ^{6}Li excitation energy bins; this method preserves the kinematic energy—angle relationships in the emitted neutron spectra. Finally, correlated error data were added up to a neutron energy of 1 MeV, triton angular distributions from the ^{6}Li(n,t)^{4}He reaction were included below 1 MeV, and radioactive decay data were added to Files 8 and 9. Except for the covariance and (n,t) angular distribution files, the evaluation covers the neutron energy range of 10^{-5} eV to 20 MeV.

39893 (LA—7663-MS, pp 54-62) **Summary documentation for ^{10}B.** Hale, G.M.; Stewart, L.; Young, P.G. (Los Alamos Scientific Lab., NM). Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

All cross sections below a neutron energy of 1.5 MeV except the (n,p) and (n,t) reactions were revised for the Version V evaluation of ^{10}B (MAT 1305). The data above 1.5 MeV were carried over from ENDF/B-IV. Other changes to the file include the addition of evaluated cross sections and secondary gamma-ray spectra from the ^{10}B(n,γ)^{11}B reaction, as well as covariance data for cross sections below 1.5 MeV. Except for the covariance file, the evaluated data cover the energy range from 10^{-5} eV to 20 MeV. Partial documentation is provided in LA-6472-PR (1976) and LA-6518-MS (1976). 2 figures.

39894 Absolute cross sections for three-body breakup reactions ^{6}Li(d,n ^{3}He)^{4}He and ^{6}Li(d,p ^{3}H)^{4}He. Holland, R.E.; Elwyn, A.J.; Davids, C.N.; Lynch, F.J.; Meyer-Schuetzmeister, L.; Monahan, J.E.; Mooring, F.P.; Ray, W. Jr. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 3, 592-600(Mar 1979).

Absolute cross sections have been obtained for the reactions ^{6}Li(d,n^{3}He)^{4}He and ^{6}Li(d,p^{3}H)^{4}He for deuteron energies from 100 to 800 keV. The energy spectra of particles from these reactions are continuums because of the three-body final state. Total cross sections as well as angular distributions have been obtained with accuracies of 10 to 17%. Comparisons of energy spectra are made to predictions of simple models.

39895 Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50—90 MeV. Moyle, R.A.; Glagola, B.G.; Mathews, G.J.; Viola, V.E. Jr. (Department of Chemistry and Cyclotron Laboratory, University of Maryland, College Park, Maryland 20742). *Phys. Rev., C;* **19**: No. 3, 631-640(Mar 1979).

Cross sections fo the production of A = 6, 7, 8, 9, 10, and 11 isobars in the reaction of 50—90 MeV protons with oxygen are reported. Product masses were identified by time-of-flight techniques using either a channel-plate fast-timing device or rf fast timing. Mass, kinetic energy, and angular distributions are reported for the products. The measured cross sections are applied to theories of LiBeB nucleosynthesis which involve galactic—cosmic-ray or stellar-flare reactions as a source of these elements. Both of the models underproduce the observed ^{7}Li/^{6}Li ratio by an order of magnitude, which supports previous conclusions that an additional source of ^{7}Li is required for its synthesis. However, the models give reasonable agreement for the ^{11}B/^{10}B, ^{6}Li/Be and B/^{6}Li ratios, although the galactic ray model predicts a ^{11}B/^{10}B ratio that is low by a factor of 2. In addition the B/^{6}Li ratio is consistent only with a low value for the natural boron abundance.

39896 Low energy π^+ scattering from light nuclei. Dytman, S.A.; Amann, J.F.; Barnes, P.D.; Craig, J.N.; Doss, K.G.R.; Eisenstein, R.A.; Sherman, J.D.; Wharton, W.R.; Burleson, G.R.; Verbeck, S.L.; Peterson, R.J.; Thiessen, H.A. (Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., C;* **19**: No. 3, 971-986(Mar 1979).

Angular distributions for elastic and inelastic scattering of ~ 50 MeV π^+ projectiles from targets of ^{12}C, ^{16}O, Si, and Fe are reported. Systematic differences between the experimental results and predictions of some first-order theories constructed from free π-N amplitudes are observed for all cases studied. These discrepancies are similar to those reported earlier. Although several improved optical models exist which take into account better treatments of the first-order potential as well as some second-order effects such as π absorption and the Lorentz-Lorentz effect, good agreement with the data cannot be achieved without a phenomenological adjustment of the potential parameters. A purely phenomenological Kisslinger potential when used to fit the data yields potential parameters which are independent of mass number over the A region studied. The resulting p-wave parameter b_1 is close to the value predicted from free πN models, while the s-wave parameter b_0 requires severe adjustment of both real and imaginary parts from the value predicted from free πN models. The inelastic results are compared to distorted-wave Born-approximation calculations, which are seen to manifest characteristics similar to those seen in the elastic channel. A common optical potential is found to provide a good description of both elastic and inelastic scattering.

39897 New measurement of the ^{6}Li(n,α)T cross section. Lamaze, G.P.; Schrack, R.A.; Wasson, O.A. (National Bureau of Standards, Washington, DC). *Nucl. Sci. Eng.;* **68**: No. 2, 183-188(Nov 1978).

The shape of the ^{6}Li(n,α)T cross-section curve was measured from 3- to 800-keV neutron energy. The neutrons were produced by the National Bureau of Standards 140-MeV Linac, and the measurements were made along the 200-m above-ground drift tube. The neutron flux was monitored by a 61-cm-long hydrogen gas proportional counter giving a direct ratio of the ^{6}Li(n,α) cross section to the H(n,p) cross section. The ^{6}Li(n,α) events were detected in a 0.5-mm-thick piece of ^{6}Li glass (NE-912). The results were normalized to ENDF/B-V in the region from 10 to 400 keV. Overall uncertainties in the measurement are ~ 2% in the range from 10 to 400 keV. Error analysis and comparisons with previous measurements are given. 9 references.

39898 Excitation function for ^{15}O production via the ^{14}N (d,n)^{15}O reaction. Ruiz, H.V.; Wolf, A.P. (Brookhaven National Lab., Upton, N.Y. (USA). Dept. of Chemistry). *Radiochim. Acta;* **24**: No. 2, 65-67(1977).

Absolute cross section for the ^{14}N (d,n)^{15}O reaction by the saturation method at deuteron bombarding energies ranging from 0.6 up to 14.35 MeV were measured at the Brookhaven tandem Van de Graaff Facility. The irradiations were carried out on nitrogen gas contained in quartz cells with aluminium foil windows. The excitation curve obtained has a shape which compares well with previously published results, as does the position of its maximum at 2.8 MeV. The absolute cross-sections, however, show considerable discrepancies.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39899, 39900

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39887, 39896

39899 (AD-A—057898) **Inelastic electron scattering in $_{28}$Si between 4 MeV and 50 MeV excitation energy. Master's thesis.** Hunter, E.E.; Pozinsky, G. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1978. 62p. NTIS PC A04/MF A01.

91.2 MeV electrons were used to study $_{28}$Si in the excitation range from 4 to 50 MeV. Fragmentation of E2 strength into states below the GQR region was found, with states between 0 and 15 MeV exhausting 35% of the E2 isoscalar EWSR. Available (gamma, abs) data were used to disentangle E1 and E2 strength in the region 15 to 30 MeV and show E2 strength separated into two distinct groups in this region. A cluster of E2 strength centered at 17.5 MeV and believed to be in the oblate ground state well exhausts 22% of the E2 isoscalar EWSR and a broad but clearly separate group of strength from 20 to 30 MeV exhausts 65% of the E2 isovector EWSR. Significant transition strength was found between 30 and 50 MeV which exhausts between 25 and 35% of the total E2 EWSR. Evidence was found for the existence of an E2 giant resonance corresponding to the oblate well of 28Si at 24 MeV.

39900 (ORNL/TM—6637) **Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons.** Hetrick, D.M.; Larson, D.C.; Fu, C.Y. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 42p. (ENDF—280). Dep. NTIS, PC A03/MF A01.

ENDF/B-V neutron emission spectra induced by 14.6 MeV incident neutrons are graphically compared with experimental data. The elements selected for the comparisons include Na, Mg, Al, Si, Ca, Ti, V, Cr, Fe, Ni, Cu, Nb, W, and Pb. Partial as well as total spectra from the ENDF/B-V evaluations are shown in each graph, while experimental data were available only for the total. Energy distribution laws utilized for the reaction types in each element are explained. Agreement between evaluated and experimental data is discussed, and recommendations for improvements are made. In general, evaluations which utilized advanced nuclear model codes, including precompound effects, agree well with measured spectra.

39901 Spallation of aluminum by 300 GeV protons. Kaufman, S.B.; Weisfield, M.W.; Steinberg, E.P.; Wilkins, B.D.; Henderson, D.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 3, 962-964(Mar 1979).

Activation cross sections were measured for the nuclides ^{7}Be, ^{11}C, ^{13}N, ^{18}F, ^{22}Na, and ^{24}Na formed by the interaction of 300 GeV protons with aluminum. The measurements were made relative to the production of ^{11}C in polyethylene and graphite foils. The cross section ratios are the same within experimental error as those observed at 28 GeV.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39900

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39887, 39900

39902 (INIS-mf—4427, pp 44) **Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39.** Maguire, C.F.; Bomar, G.B.; Ramayya, A.V.; Piercey, R.B. (Vanderbilt Univ., Nashville, Tenn. (USA)); Ford, J.L.C.; Gomez del Campo, J.; Shapira, D.; Hensley, D. (Oak Ridge National Lab., Tenn. (USA)). 1978.

From Conference on dynamical properties of heavy-ion reactions; Johannesburg, South Africa (1 Aug 1978).

39903 (LA-UR—79-839) **πi and π^- elastic scattering from ^{40}Ca at 65 MeV.** Dam, S.H.; Edge, R.D.; Preedom, B.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-790347—3). Dep. NTIS PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Angular distributions for the elastic scattering of 65 MeV π^+ and π^- beams from calcium 40 were measured. Preliminary data are shown for differential cross sections. 2 references. (JFP)

39904 Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni. Flynn, E.R.; Brown, R.E.; Correll, F.D.; Hanson, D.L.; Hardekopf, R.A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **42**: No. 10, 626-629(5 Mar 1979).

The (t/sub pol/,d) reaction at 16 MeV has been used to determine the total angular momentum of levels in ^{59}Ni and ^{65}Ni. This represents the first reported results of this reaction using a polarized triton beam. The data indicate distinct differences and advantages over (d/sub pol/,p) data at similar bombarding energies. The (t/sub pol/,d) reaction is used on ^{58}Ni to compare data with distorted-wave Bron-approximation predictions for known spin states and on ^{64}Ni to resolve an important controversy over spin values in ^{65}Ni.

39905 Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca. Renner, T.R. (Department of Physics, University of Chicago, Chicago, Illinois 60637). *Phys. Rev., C;* **19**: No. 3, 765-776(Mar 1979).

Angular distributions between 3 and 110 degrees in the laboratory system were measured for the elastic scattering of ^{12}C form / sup 40,42,48/Ca at 51.0, 49.9, and 47.2 MeV, respectively. Pronounced oscillations were observed in the ^{12}C + ^{40}Ca angular distribution. Weaker oscillations were observed in the ^{12}C + ^{42}Ca angular distributions while none were seen in ^{12}C + ^{48}Ca. An optical-model analysis was performed using Woods-Saxon and folded potentials. Surface transparent potentials were found to parameterize the oscillatory structure of the forward-angle data of ^{12}C + ^{40}Ca. Stronger surface absorption in the ^{12}C + /sup 42,48/Ca imaginary potentials apparently weakens or washes out any forward-angle oscillations. Optical potentials that fit forward-angle data of ^{12}C + ^{40}Ca also predict oscillatory structure in the excitation function at 180°.

39906 Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV. Anderson, B.D.; Bevington, P.R.; Cverna, F.H.; McNaughton, M.W.; Willard, H.B.; Barrett, R.J.; King, N.S.P.; Ernst, D.J. (Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev., C;* **19**: No. 3, 905-912(Mar 1979).

Proton total reaction cross sections for 700 MeV protons on / sup 40,44,48/Ca have been measured by detecting inelastically scattered particles at angles greater than 10° (lab). The measurements were performed with overall uncertainties of +- 6.2% and relative uncertainties of +- 2.5%. These measurements yield the values of σ/sub R/(^{40}Ca) = 614 mb, σ/sub R/(^{44}Ca) = 643 mb, and σ/sub R/(^{48}Ca) = 736 mb. Matter radii differences Δ (44-40) = (0.05 +- 0.09)fm and Δ (48-40) = (0.36 +- 0.09)fm were extracted based on a theoretical calculation which takes advantage of the geometrical nature of the cross section. The results are compared to other available measurements of total reaction cross sections on medium-weight nuclei at medium energies and to other determinations of the matter radii differences for the calcium isotopes.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

REFER ALSO TO CITATION(S) 39834

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39900, 39904

39907 Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr. DiGiacomo, N.J.; Boudrie, R.L.; Brissaud, I.; Kraushaar, J.J.; Peterson, R.J.; Ristinen, R.A.; Rost, E.S.; Smith, G.R. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80309). *Phys. Rev., C;* **19**: No. 3, 1132-1135(Mar 1979).

Differential cross sections for elastic and inelastic scattering of 0.8 GeV protons from ^{89}Y and ^{90}Zr have been measured to momentum transfers of 3.8 fm^{-1}. The results were analyzed in terms of a relativistic nuclear optical model and indicate that the elastic and inelastic scattering are dominated by surface features of the nucleus. The effect of the spin orbit term in the optical potential on the inelastic cross sections appears to be small.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39900, 39907

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

39908 (BNL—25877) **Unique parity states in ^{109}Pd from the (n,γ) reaction: calculations for rotation aligned and odd mass IBA models.** Casten, R.F.; Smith, G.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790323—3). Dep. NTIS, PC A02/MF A01.

From Symposium on high spin phenomena in nuclei; Argonne, IL, USA (15 Mar 1979).

New experimental results are first summarized on unique parity states in ^{109}Pd that permit a sensitive test of these models. Calculations are then presented using the various models considered. The empirical levels are of low spin and constitute essentially the entire set of both favored and unfavored low spin antialigned levels in ^{109}Pd arising from the coupling of an h/sub 11/2/ particle to a rotor core. The data stem from a series of experiments involving the (n,γ) reaction of palladium-108. 21 references (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39834

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39834

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39900, 39907

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39885, 39900, 39915

39909 (ANL/NDM—46) **Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region.** Smith, A.; Guenther, P.; Winkler, G.; Whalen, J. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 36p. Dep. NTIS, PC A03/MF A01.

Neutron total cross sections are measured from 0.25 to 4.5 MeV at intervals of less than or approx. = to 10 keV. Neutron differential elastic- and inelastic-scattering cross sections are measured from 1.5 to 4.0 MeV at intervals of less than or equal to 0.2 MeV. Cross sections for scattering into more than 20 energy groups are determined. Cross sections calculated from an optical-statistical model are in quantitative agreement with measured neutron total and elastic-scattering cross sections and in qualitative agreement with measured neutron inelastic-scattering cross sections. In the context of this model, significant dependence of the inelastic-scattering process on parity and/or deformation is not in evidence. The interpretation of the observed neutron inelastic-neutron-scattering results is consistent with previous reported J/sup π/ assignments and the systematics of nuclear-level-densities. 29 references.

39910 (CONF-790602—41) **Doppler effect measurements on solid and liquid Sn.** Tsang, F.Y.; Brugger, R.M. (Idaho National Engineering Lab., Idaho Falls (USA); Missouri Univ., Columbia (USA)). 1978. Contract EY-76-C-07-1570. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Neutrons at 24 keV were used to measure the integrated neutron transmission of relatively thick tin samples as a function of thickness and temperature. The effective total cross sections are plotted and discussed as a function of the Doppler effect, temperature resonance self-shielding, and thickness. 6 references. (JFP)

39911 (INIS-mf—4427, pp 22) **Effect of nuclear deformation on heavy-ion fusion.** Stokstad, R.G. (Oak Ridge National Lab., Tenn. (USA)); Eisen, Y.; Kaplanis, S.; Pelte, D.; Smilansky, U.; Tserruya, I. (Weizmann Inst. of Science, Rehovoth (Israel)). 1978.

From Conference on dynamical properties of heavy-ion reactions; Johannesburg, South Africa (1 Aug 1978).

39912 Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36. Baktash, C.; der Mateosian, E.; Kistner, O.C.; Sunyar, A.W. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **42**: No. 10, 637-640(5 Mar 1979).

States of ^{154}Er were studied by means of the (^{16}O,4n) and (^{64}Ni,4n) reactions. Beginning with a 40-nsec isomeric state [J/sup π/ = (10$^-$,11$^-$)], an intensely populated unusual cascade of $\Delta J = 2$ and $\Delta J = 1$ transitions was established up to spin (35,36) and 12.5 MeV excitation. On an E vs I (I + 1) plot the yrast levels form a series of straight-line segments with side feeding occurring primarily at the ends of segments . A second cascade of even-spin, even-parity levels from the ground state to J/sup π/ = 18$^+$ (quasi-ground-state band) does not exhibit these properties.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39834

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39900

39913 Levels in ^{165}Ho populated in the ^{166}Er(t(pol),α) reaction. Loehoeiden, G. (Bergen Univ. (Norway)); Burke, D.G.; Hirning, C.R. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.); Flynn, E.R.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Phys., A;* **303**: No. 1, 1-13(26 Jun 1978).

The ^{166}Er(t(pol),α)^{165}Ho reaction has been studied using 17 MeV tritons with a polarization of approximately 0.81 from the Los Alamos tandem Van de Graaff accelerator facility. The reaction products were momentum analyzed with a Q3D magnetic spectrometer and detected with a helical-cathode position-sensitive proportional counter. The analyzing powers were large, and the (t(pol),α) reaction was found to be a very powerful technique for spin determinations in this mass region. The data also made it possible to give Nilsson model assignments for some levels for which previous information was conflicting or incomplete.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39900, 39911, 39913

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39834

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39885, 39887, 39900

39914 (LBL—8613) **Dynamical birth and thermal death of angular momentum in heavy ion reactions.** Moretto, L.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 6p. (CONF-790140—4). Dep. NTIS, PC A02/MF A01.

From International workshop on gross properties of nuclei and nuclear excitations VII; Hirschegg, Kleinwalsertal, Austria (15 Jan 1979).

Dynamical and equilibrium angular momentum fractionation as well as equilibrium angular momentum distributions associated with a variety of collective modes of the intermediate complex are described.

39915 Energy dependence of peripheral reactions induced by heavy ions. Gelbke, C.K.; Olmer, C.; Buenerd, M.; Hendrie, D.L.; Mahoney, J.; Mermaz, M.C.; Scott, D.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Rep.;* **42**: No. 5, 311-358(Jun 1978).

Collisions of ^{16}O ions on targets of ^{94}Zr, ^{197}Au, ^{208}Pb and ^{232}Th are investigated at incident energies of 140 and 315 MeV and compared to published data on peripheral collisions at 33.6 GeV. At 140 MeV, the isotope-production cross sections resemble the ground-state Q-value systematics characteristic of a partially-equilibrated, di-nuclear system formed in deeply-inelastic scattering. The yields are independent of shell and pairing effects in the target and residual nuclei. The results are interpreted with simple friction and fragmentation models and are compared to observations at 33.6 GeV.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

39916 Octupole-octupole residual interactions and low-lying 0$^+$ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U. Chasman, R.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **42**: No. 10, 630-633(5 Mar 1979).

Solutions applicable for all interaction strengths are obtained for a schematic Hamiltonian with pairing forces and particle-hole octupole-octupole forces. The method is applied to the light U isotopes. Adjusting the particle-hole interaction strength to the measured K/sup π/ = 0$^-$ excitation energies leads to an immediate explanation for the low-lying 0$^+$ excited states in this region.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39834, 39922

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39834

39917 (LA—7722-PR, pp 11-13) **Calculation of prompt fission neutron spectra.** Madland, D.G.; Nix, J.R. Mar 1979.

In Applied nuclear data research and development. Progress report, October 1—December 31, 1978.

The dependence of the prompt fission neutron spectrum on both the fissioning nucleus and its excitation energy is studied by use of standard nuclear-evaporation theory to calculate the ncutron energy spectrum in the fission-fragment center-of-mass system, and then transform these results to the laboratory system. The dependence is calculated with constants determined a priori. Results are shown for neutron fission of ^{251}Cf at 0.53 MeV and ^{235}U at 0.53 and 14.1 MeV. 2 figures. (RWR)

39918 (ORO—5126-62) **Energy dissipation in ^{235}U(n/sub th/,f).** Schultheis, H.; Schultheis, R. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1978. Contract EY-76-S-05-5126. 10p. Dep. NTIS, PC A02/MF A01.

The maximum energy available for dissipation in the thermal-neutron induced fission of ^{235}U was determined on the basis of the calculated (static) potential energy and the experimental post-scission data. High dissipation is found to be incompatible with experiment. 18 references.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

39919 (BNL-tr—678) **Detection of a new spontaneously fissioning nuclide in some meteorites.** Flerov, G.N.; Ter-Akop'yan, G.M.; Popeko, A.G.; Fefilov, B.V.; Subbotin, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1977. Translation of J.I.N.R. Preprint P6-10581. 13p. Dep. NTIS, PC A02/MF A01.

The results of a determination of the concentration of the uranium impurity in the representative meteorite samples, the conduction of direct measurements of the background due to cosmic radiation, and finally, to measure once more the multiple neutron emission from the meteorite. The data presented indicate the presence of a previously unknown long-lived spontaneously fissioning nuclide in the samples examined. This nuclide probably belongs in the region of superheavy elements. If the half-life is 10^9 years, then the concentrations would be in the range 3×10^{-9} to 3×10^{-8} ppM for different meteorites, corresponding to 6×10^9 to 6×10^{10} atoms per kilogram of the material. 20 references. (JFP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39900

39920 Electric monopole transitions and excited 0$^+$ states in ^{250}Cf. Ahmad, I.; Chasman, R.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 3, 1140-1143(Mar 1979).

E0 transitions identified in ^{250}Cf establish two excited 0$^+$ states at 1154.2 and 1266.5 keV with dimensionless ratios X of 0.27 +- 0.03 and 2.5 +- 0.3, respectively. This is the heaviest nucleus in

which excited 0^+ states have been observed. Using density-dependent pairing matrix elements and appropriate single-particle energies we have calculated the energies of seniority 0 $K\pi = 0^+$ excited states to be 1310 and 1620 keV and the energy of the lowest $s = 2\ 0^+$ state as 1430 keV. These calculations suggest that the 1154.2 keV state is probably the lowest pair vibration and the 1266.5 keV state is possibly the lowest $s = 2\ 0^+$ state.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39915

39921 (LA—7663-MS, pp 125-132) **Summary documentation for ^{242}Pu.** Mann, F. (Hanford Engineering and Development Lab., Richland, WA); Schenter, R.; Madland, D.G.; Young, P.G. Jan 1979.

In Summary documentation of LASL nuclear data evaluations for ENDF/B-V.

A new evaluation of neutron-induced reactions on ^{242}Pu was performed for Version V of ENDF/B (MAT 1342). These evaluations are documented in HEDL-TME-77-54 and LASL-7533-MS. Additionally, decay and gamma-ray production data are obtained. The evaluation covers the energy range 10^{-5} eV to 20 MeV, and includes covariance data at all energies. 3 figures.

39922 (LA-UR—78-3062) **Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV.** Madland, D.G.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 41p. (CONF-781174—1). Dep. NTIS, PC A03/MF A01.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

An evaluation of the n + ^{242}Pu cross sections is presented for the neutron energy range of 10 keV to 20 MeV. The total fission and radiative capture cross sections are based upon experimental measurements of ^{242}Pu. The remaining cross sections, together with the elastic and inelastic angular distributions to low lying states were calculated using various reaction models. An expression is presented for the energy dependence of the average number of neutrons produced per fission. The results were placed in ENDF/B-V format and combined with a recent evaluation of data below 10 keV by the Hanford Engineering Development Laboratory, so that a complete data set covering the energy range of 10^{-5} eV to 20 MeV is available. 41 references.

39923 (UCRL—81909) **Review of the microscopic cross sections for the americium isotopes in the resolved resonance region.** Browne, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Nov 1978. Contract W-7405-ENG-48. 19p. (CONF-781174—2). Dep. NTIS, PC A02/MF A01.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The differential cross section measurements for ^{241}Am, /sup 242m/Am and ^{243}Am are reviewed in the energy range from 0.5 eV to 10 keV. Parameters extracted from resonance analysis, such as the neutron strength function, the average level spacing, the average capture and fission widths, are compared for the various measurements. The average capture and fission cross sections from 100 eV to 10 keV are directly compared. The status of the data set is discussed with suggestions for further measurements. 24 references.

39924 Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium. Wilkins, B.D.; Steinberg, E.P.; Kaufman, S.B. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **19**: No. 3, 856-867(Mar 1979).

Measurements of the number and kinetic energy distribution of He ions formed in the 11.5-GeV proton bombardment of uranium were made with a particle telescope as a function of the angle between the He ion and the direction of a heavy fragment. The mass of the latter was determined in a time-of-flight system. No correlation in the intensity or energy of He ions with the direction of the heavy fragment was observed. This is interpreted as an indication that the He ions are formed prior to or simultaneously with the formation of the heavy fragments rather than being evaporated from an excited, fully accelerated fragment. In the case of fission fragments these results provide direct evidence that fission does not occur as a prominent process at high excitation energy (E^*), but rather, is essentially a low energy phenomenon. Current formulations of Γ/sub f//Γ/sub n/ predict a large proportion of fission at high E^* for the nuclides involved here, in disagreement with the results of the present experiment. An estimate is made of the relative deposition energy involved in the reactions as a function of the energy and mass of the heavy fragment formed. This clearly shows that the region of $30 < \text{or} \simeq A < \text{or} \simeq 70$ is associated with the highest deposition energy. This is just the region of the so-called "fragmentation" products whose recoil properties provide evidence for the existence of a specific high-energy reaction mechanism.

39925 Incomplete momentum transfer in peripheral heavy-ion collisions at 20 MeV/nucleon. Dyer, P.; Awes, T.C.; Gelbke, C.K.; Back, B.B.; Mignerey, A.; Wolf, K.L.; Breuer, H.; Viola, V.E. Jr.; Meyer, W.G. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev. Lett.;* **42**: No. 9, 560-563(26 Feb 1979).

Profectile residues have been studied in coincidence with fragments resulting from fission of the target residue for reactions induced by 315-MeV ^{16}O ions on a ^{238}U target. A kinematical analysis shows that the forward linear momentum transferred to the target nucleus is significantly smaller than that expected for simple transfer reactions, but larger than that expected for pure profectile fragmentation processes.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39378, 39921, 39923, 39924

39926 (AD-A—059327) **Fission product yields from 6—9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis.** Chapman, T.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). 1977. 79p. NTIS PC A05/MF A01.

The yields of 28 mass chains have been measured for fission of U^{235} and U^{238} induced by neutrons at four different energies from 6.0 to 9.1 MeV. This is the first experimental measurement where sufficient energy resolution was obtained to observe the effect of the onset of second-chance fission in the case of symmetric fission. The Ag^{111} results are compared with measurements at other neutron energies and with previous theoretical predictions. Several of the nuclide results are presented in graphical form and all nuclide results are presented in tabular form, as a function of neutron energy. The mass chains measured range from 84 to 156, and their half-lives range from 18 minutes to 30 years.

39927 Absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu at 13.9 and 14.6 MeV. Cance, M.; Grenier, G. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge France). *Nucl. Sci. Eng.;* **68**: No. 2, 197-203(Nov 1978).

Measurements of the absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu were made at 13.9 and 14.6 MeV with a double 4π ionization chamber. The associated particle method with the time-of-flight technique was used. Final values of σ/sub nf/(^{235}U), σ/sub nf/(^{238}U), σ/sub nf/(^{239}Pu), σ/sub nf/(^{238}U)/σ/sub nf/(^{235}U), and σ/sub nf/(^{239}Pu)/σ/sub nf/(^{235}U) are compared to previous data. 21 references.

NUCLEAR THEORY

NUCLEAR STRUCTURE

39928 Giant E1 mode and its energy broadening from the charge distributions in heavy-ion reactions. Moretto, L.G.; Sventek, J.; Mantzouranis, G. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **42**: No. 9, 563-566(26 Feb 1979).

The narrow experimental width of the Z distribution at fixed mass asymmetry in heavy-ion reactions is interpreted in terms of a giant dipole mode whose damping increases with excitation energy. Further theoretical predictions and relevant experiments are discussed.

39929 Coherent residual interactions: pairing plus particle-hole. Chasman, R.R. (Argonne National Lab., IL (USA)); Ogle, W. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Phys., A;* **303**: No. 1, 67-95(26 Jun 1978).

Exact solutions for a schematic Hamiltonian with pairing and particle-hole residual interactions are presented. These solutions are compared with approximate solutions obtained using an extended equations of motion approach and with approximate solutions obtained using a generalized form of the method of correlated quasiparticles. Applications of these approximate methods to some nonschematic problems are suggested.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 39931

39930 (N—78-31019) **Many-particle theory of nuclear system with application to neutron-star matter and other systems. Semiannual status report, February, 1978—July 1978.** Yang, C.H. (Southern Univ., Baton Rouge, LA (USA). Dept. of Physics). 25 Aug 1978. Contract NGR-19-005-006. 7p. NTIS PC A02/MF A01.

General problems in nuclear-many-body theory were considered. Superfluid states of neutron star matter and other strongly interacting many-fermion systems were analyzed by using the soft-core potential of Reid. The pion condensation in neutron star matter was also treated.

NUCLEAR REACTIONS AND SCATTERING

39931 (COO—3235-85) **Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977—October 31, 1978.** (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Nov 1978. Contract EY-76-S-02-3235. 29p. Dep. NTIS, PC A03/MF A01.

Theoretical research on nuclear reaction kinetics and excitations is summarized. A list of publications is included. (JFP)

39932 (COO—3496-70) **Role of the conservative potential and dissipation in heavy-ion fusion.** Huizenga, J.R.; Birkelund, J.R.; Tubbs, L.E.; De, J.N.; Sperber, D. (Rochester Univ., NY (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). 1979. Contract EY-76-S-02-3496. 6p. (CONF-790140—1). Dep. NTIS, PC A02/MF A01.

From International workshop on gross properties of nuclei and nuclear excitations VII; Hirschegg, Kleinwalsertal, Austria (15 Jan 1979).

Currently available data on fusion excitation functions for heavy-ion induced reactions over a wide mass range are compared to results calculated with a classical dynamical model based on the proximity nuclear potential and the proximity one-body nuclear friction. Good agreement is obtained.

39933 (INIS-mf—4427, pp 27) **Angular momentum transfer in deep inelastic scattering. Experimental evidence and a model based upon particle transfer.** Moretto, L.G. (California Univ., Berkeley (USA). Dept. of Chemistry). 1978.

From Conference on dynamical properties of heavy-ion reactions; Johannesburg, South Africa (1 Aug 1978).

39934 (LBL—8758) **Multipion production in nuclear collisions.** Gyulassy, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 13p. (CONF-790347—6). Dep. NTIS, PC A02/MF A01.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Two aspects of multipion production in nuclear collisions are discussed: the negative pion multiplicity distribution and the $\pi^-\pi^-$ correlation function. The emphasis is on how these observables could be used to search for signals of collective phenomena in nuclear collisions. 2 figures.

39935 Abrasion-ablation calculations of large fragment yields from relativistic heavy ion reactions. Oliveira, L.F.; Donangelo, R.; Rasmussen, J.O. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., C;* **19**: No. 3, 826-833(Mar 1979).

Calculations of large mass fragment yields from high-energy heavy-ion reactions are performed based on the abrasion-ablation model. The geometrical picture of the cleancut fireball model is used to calculate the number of participant nucleons in the abrasion stage and the excitation energy of the spectators (primary residues). A standard statistical evaporation code is used to calculate the ablation stage. Results from this model show an overall agreement with experimental data, although some systematic discrepancies are found and discussed. A final-state interaction is introduced which increases the average excitation energy of primary fragments and improves the results considerably.

39936 Converged values of second-order core-polarization diagrams with orthogonalized-plane-wave intermediate states. Kung, C.L.; Kuo, T.T.S.; Ratcliff, K.F. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Phys. Rev., C;* **19**: No. 3, 1063-1082(Mar 1979).

We carry out an extended study of the Vary-Sauer-Wong effect on the second-order core-polarization diagrams G/sub 3p1h/ and G/sup T//sub 3p1h/ in the effective interaction between two valence nucleons. As in Vary, Sauer and Wong, we first calculate G/sub 3p1h/ using a harmonic oscillator propagator for the intermediate particle states p, including particle-hole excitations with energies up to 22hω. Results are in close agreement with those of Vary, Sauer, and Wong. We then calculate G/sup T//sub 3p1h/ where a free particle propagator for p is used. This is obtained by including the -U, the oscillator one-body potential, insertions of all orders to p of G/sub 3p1h/. Although the resulting matrix elements are generally smaller in magnitude than those of Vary, Sauer, and Wong, the qualitative feature of the Vary-Sauer-Wong effect is clearly maintained. Namely there are strong cancellations between the contributions from the low and high energy p states. This makes the net effect from the core polarization diagrams significantly weaker than from G/sub 3p1h/ calculated with 2hω excitations alone. We also study some intermediate choices for the propagator of p, where the free particle propagator is used only for high energy valence states. The Brueckner reaction matrix elements in a mixed representation where one particle is in a harmonic oscillator state and the other in a plane wave state are needed in our calculations. By using the vector transformation brackets of Wong and Clement and of Balian and Brezin and the Tsai-Kuo treatment of the Pauli exclusion operator, we have developed a technique for accurately calculating these matrix elements.

39937 Polarizability of nuclear wave functions in heavy ion reactions. Charlton, L.A.; Delic, G.; Glendenning, N.K.; Pruess, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *J. Phys. Soc. Jpn.;* **44**: 272-277(1978).

From International conference on nuclear structure; Tokyo, Japan (5 - 10 Sep 1977).

Evidence is presented for the polarizability of nuclear wave functions in heavy ion transfer reactions. The polarization of the wave function of the transferred nucleon is largest for weakly bound nucleons, depends on the bombarding energy, being largest for low energy (slow) collisions, and produces a shift toward forward angle. Results of an adiabatic estimate employing two-center shell model wave functions in a DWBA amplitude are presented. A dynamical theory is sketched which involves a superposition of many transitions through excited bound and continuum states of the weakly bound nucleon. It is shown how the adiabatic amplitude emerges as the lowest approximation.

SPONTANEOUS AND INDUCED FISSION

39938 (LA-UR—79-533) **Experimental survey of the potential energy surfaces associated with fission.** Britt, H.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 34p. (CONF-790507—1; IAEA-SM—241-A1). Dep. NTIS, PC A03/MF A01.

From IAEA symposium on physics and chemistry of fission; Julich, F.R. Germany (14 May 1979).

Progress in the experimental determination of the properties of the potential energy surface associated with fission is reviewed. The importance of nuclear symmetry effects on the calculation of fission widths is demonstrated. Evidence is presented for the fragmentation of the mass asymmetric second barrier in the thorium region and the axial asymmetric first barrier in the californium region. Detailed analyses of experimental data suggest the presence of two parallel second barriers; the normal mass asymmetric, axial symmetric barrier and a slightly higher mass symmetric, axial asymmetric barrier. Experimental barrier parameters are determined systematically and compared to calculations from various theoretical models. Techniques for expanding fission probability measurements to higher energies are discussed. 53 references.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

39939 (AD-A—057881) **Inverse mean free path, stopping power, csda range, and straggling in polystyrene for electrons of energy < or = 10 keV. Interim technical report.** Ashley, J.C.; Tung, C.J.; Ritchie, R.H.; Anderson, V.E. (Oak Ridge National Lab., TN (USA)). Feb 1978. Contract Y77-6. 26p. NTIS PC A03/MF A01.

The interaction of electrons with solid polystyrene, -(C^8H^8)-, is described, based on a model insulator theory to account for the response of the valence electrons, and carbon K-shell ionization cross sections derived from atomic, generalized oscillator strengths. Contributions to the inverse mean free path and energy loss due to these two excitation processes are tabulated for incident electrons with energies from 5 eV to 10 keV. Electron ranges in the continuous-slowing-down approximation and straggling are tabulated for electrons with energies from 15 eV to 10 keV.

39940 Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets. Knudsen, H.; Moak, C.D.; Jones, C.M.; Miller, P.D.; Sayer, R.O.; Alton, G.D.; Bridwell, L.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **19**: No. 3, 1029-1037(Mar 1979).

Absolute charge-state yields of 20-MeV Fe ions emerging within a large acceptance angle from a differentially pumped gas cell of length 9.4 cm have been measured using N_2, Ar, Kr, Xe, and SF_6 targets. The gas pressures ranged from 2 to 400 mTorr, thereby including target thicknesses where single events dominate the charge change, as well as target thicknesses where charge-state equilibrium is established. From the low-pressure yields total cross sections, σ/

sub 4q/ with q = 5—15 were obtained using an improved version of the initial growth method.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 39880

39941 (INIS-mf—4508, pp 14-19) **Nuclear power and neutron physics.** Kazachkovskii, O.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1977. (In Russian).

From 4. all-union conference on neutron physics; Kiev, USSR (18 Apr 1977).

Principle demands in the field of neutron physics due to the development of nuclear power (first of all fast breeder reactors) are outlined. The problem is emphasized to ensure such a quality of neutron data that would permit not to develop critical assemblies for the next generations of fast reactors. The highest possible accuracy of the measurements is to be reached. This has a direct bearing on the phenomenon of nuclear fission that is closely related to one of the most pressing problems of contemporary nuclear physics - the problem of collective motion of nuclear matter.

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

39942 (M—100) **Multigamma-ray calibration sources.** Meyer, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Dec 1978. Contract W-7405-ENG-48. 55p. Dep. NTIS, PC A04/MF A01.

Tables are presented for the results of measurement and analysis of a primary and secondary set of multigamma-ray calibration sources that were developed and found useful. Some multigamma ray source values are also included. 15 references. (JFP)

39943 **Neutron flux monitoring and data analysis for neutron standard reaction cross sections.** Wasson, O.A.; Schrack, R.A.; Lamaze, G.P. (National Bureau of Standards, Washington, DC). *Nucl. Sci. Eng.;* **68**: No. 2, 170-182(Nov 1978).

The common features used in the measurement $^{6}Li(n,\alpha)$, $^{10}B(n,\alpha\gamma)$, and $^{235}U(n,f)$ cross sections presented in three subsequent papers are described. The experiments were performed on the 200-m flight path of the National Bureau of Standards Linac and cover the neutron energy region from 5 to 800 keV. The neutron flux monitor was a hydrogen-filled gas proportional counter located at the end of the flight path, while the primary detectors specific to each of the three cross section measurements were placed 70 m along the flight path. The properties of the neutron source, the detailed operation of the flux monitor, the data acquisition system, and the data analysis procedure are described. The systematic errors in the neutron flux measurement are given. 6 references.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 39189

39944 (AD-A—058269) **Cryogenics at the University, of Virginia. Final technical report.** (Virginia Univ., Charlottesville (USA). Dept. of Physics). 15 Jun 1978. Contract N00017-75-C-0845. 20p. NTIS PC A02/MF A01.

This is the final report on a contract which has provided helium gas for the Liquid Helium Facility at the University of Virginia. The largest use is centered on solid state and low-temperature physics research connected with electronic properties of materials, superconductivity, magnetism, electronic devices and liquid helium. In addition a number of instruments operating at liquid helium temperatures are used for a broader range of research in many departments and at the National Radio Astronomy Laboratory. Seventeen faculty members presently use liquid helium as a major part of their research programs and others utilize instruments and cryostats on an available basis for some aspects of their research.

39945 (CONF-790342—1) **Structure solution methods for superstructures.** Johnson, C.K. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From US-Japan seminar on long-range in ordering in Crystals; Honolulu, HI, USA (18 Mar 1979).

The analysis techniques described are applicable mainly to superstructures and modulated structures without significant disorder. Other methods not discussed here are needed for handling disorder and diffuse intensity problems. Mechanistic perturbation techniques and conventional crystallographic techniques, suitably modified, are both applicable in crystal structure analysis of superstructures and modulated structures. It is strongly recommended that conventional crystallographic techniques be used whenever possible because of the greater opportunity to recognize unexpected physical results not built into the trial model.

39946 (UCID—18072) **High temperature science: future needs and anticipated development in high-density shock-wave research.** Ross, M.; Ahrens, T.J.; Nellis, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Mar 1979. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

Shock-wave experiments on condensed matter currently achieve pressures up to 5 Mbar, and temperatures over 20,000°K. In this report we survey a number of experimental methods that, in the next decade, may increase the conditions by an order of magnitude. These advanced experiments will allow us to investigate a new range of physics problems.

39947 **Yang-Lee edge singularity in the hierarchical model.** Baker, G.A. Jr.; Fisher, M.E.; Moussa, P. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **42**: No. 10, 615-618(5 Mar 1979).

The edge of the gap in the distribution of the Yang-Lee zeros is concluded to be a singular point of square-root type in all hierarchical models, in distinction to expectations based on renormalization-group arguments for short-range models in dimensions $d < 6$.

39948 (UCRL-Trans—11471) **Quasi-classical approximation of electron spectra of compressed solids.** Shpatakovskaya, G.V. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). Mar 1979. Translation of Elektronnye spektry szhatykh tverdyka tel v kvaziklassicheskom priblizhenii, Institute of Applied Mathematics, USSR Academy of Sciences, Preprint No. 96, 1976. 31p. Dep. NTIS, PC A03/MF A01.

The quasi-classical wave functions are used to calculate the electron band structure of compressed solids. Quasiclassical conditions of quantization are produced on the basis of the Thomas-Fermi model. An analytic equation is derived for the effective mass of an electron. The spectra of compressed iron and argon are calculated.

39949 **Monte Carlo study of an ordering alloy on an fcc lattice.** Phani, M.K.; Lebowitz, J.L.; Kalos, M.H.; Tsai, C.C. (Department of Mathematics and Physics, Rutgers University, New Brunswick, New Jersey 08903). *Phys. Rev. Lett.;* **42**: No. 9, 577-580(26 Feb 1979).

We report results of computer simulations of a binary alloy on an fcc lattice, equivalent to an Ising system with a nearest-neighbor antiferromagnetic interaction $J > 0$ and a next-nearest-neighbor ferromagnetic interaction $-\alpha J$, $\alpha > 0$. Our data indicate the existence of a discontinous change in energy and in sublattice magnetization as a function of temperature, for small α. For $\alpha >$ or $\simeq 0.25$, the transition appears to be continuous suggesting a tricritical point at some intermediate α.

39950 **Physics of semiconductors, 1978.** Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979). 1414p. (CONF-780919—). American Inst. of Physics, 335 East 45 Street, New York, NY.

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

Abstracts of papers presented at the conference were prepared for the data base. The conference covers a broad range of topics in semiconductor technology including: noncrystalline and narrow-gap semiconductors, impurity bands, defects, acoustics, electron-hole droplets, multi-exciton complexes, laser spectroscopy, photoemission, magneto-optics, space charge layers, and surfaces. (GHT)

39951 **Properties of the strain-confined electron-hole liquid in Ge as a function of density.** Kelso, S.M. (Univ. of California, Berkeley). pp 363-366 of Physics of semiconductors, 1978. Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979).

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

The electron-hole pair density is found to vary with position by up to a factor of three in the strain-confined electron-hole liquid (SCEHL) in Ge. The data yield a value for the compressibility of the SCEHL. In addition, properties of the liquid are studied as a function of density.

39952 **Amorphous carbon and its structural relationship to amorphous silicon and germanium.** Solin, S.A.; Wada, N.; Wong, J. (Univ. of Chicago, IL). pp 721-724 of Physics of semiconductors, 1978. Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979).

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

Raman spectra of amorphous carbon films deposited at liquid nitrogen temperature indicate only graphite like bonding. Upon annealing graphite microcrystallites develop and grow in size.

39953 Photoemission study of Al/III-V interfaces. Lindau, I.; Skeath, P.M.; Su, C.Y.; Chye, P.W.; Pianetta, P.; Spicer, W.E. (Stanford Univ., CA). pp 1055-1058 of Physics of semiconductors, 1978. Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979).

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

The photoemission technique using photon excitation energies in the energy region 6 to 600 eV has been applied to studies of aluminum overlayers on III-V semiconductor surfaces. The high surface sensitivity achievable with photoemission, (only the topmost 2 to 3 molecular layers are probed), was used to study the electronic structure of the aluminum-semiconductor interface on a microscopic scale.

39954 Angle resolved photoemission studies of the GaAs—Ge interface. Perfetti, P.; Denley, D.; Mills, K.A.; Shirley, D.A. (Univ. of California, Berkeley). pp 1081-1084 of Physics of semiconductors, 1978. Wilson, B.L.H. (ed.). Bristol, England; The Institute of Physics (1979).

From 14. conference on the physics of semiconductors; Edinburgh, UK (4 Sep 1978).

Studies of GaAs—Ge interfaces formed by evaporative deposition of Ge on cleaved (110) GaAs heated at 420°C are reported. ARUPS have been obtained along [001] direction and near X' critical point of the surface Brillouin Zone.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 39813

39955 (NBS—78-04) **Superconducting devices and materials. A literature survey issued quarterly, October—December 1978.** Edelsack, E.A.; Olien, N.A.; Schiffmacher, S.A.; Nisenoff, M.; Wolf, S.A.; Clark, A.F.; Ekin, J.W.; Fickett, F.R. (National Bureau of Standards, Boulder, CO (USA). Cryogenic Data Center). 1978. 206p. National Bureau of Standards, Boulder, CO.

Areas covered in the highlights include: new materials and fabrication processes; stability; stress effects; fusion; Josephson phenomena; superconductor standards; and patents. (GHT)

39956 Perturbation calculation of the I-V characteristic of an extended Josephson junction. Liniger, W.; Odeh, F. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). *J. Franklin Inst.;* **307**: No. 4, 245-262(Apr 1979).

The running solutions and I-V characteristic of an extended Josephson junction in a state near the ohmic regime are calculated by a perturbation method. Both the voltage-driven and current-driven cases are considered and the convergence of the perturbation procedure is proved. An integral representation of the first correction, in the I-V curve, to the ohmic regime - as well as its dependence on the external magnetic field - is given and evaluated numerically for various values of the junction parameters.

39957 Superconductivity and ferromagnetism. Balseiro, C.A.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., Sect. B. Condens. Matter;* **19**: No. 5, 2548-2555(1 Mar 1979).

In this paper a theory of superconductivity for metals in which there are localized spins is presented. The spins interact with the conduction electrons via an exchange interaction and with one another via a direct Heisenberg interaction, as well as indirectly via the conduction electrons. The spins are treated as classical vectors in a mean-field approximation. The superconducting pair-breaking mechanism is treated in the approximation of Abrikosov and Gor'kov. Complete interplay of magnetization and pair-breaking processes is taken into account. Phase diagrams are presented. A treatment of alloys of two different magnetic ions is included in a simple approximation. All results are in good qualitative agreement with the experiment.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 39841

39958 (CONF-790608—1) **Simplified design methods for nonlinear dynamic mechanical systems.** Frick, T.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Reactors Div.). 1979. Contract EY-76-C-15-2395. 33p. Dep. NTIS, PC A03/MF A01.

From 3. Canadian conference on earthquake engineering; Montreal, Canada (4 Jun 1979).

Dimensional analysis and classical methods are combined in a novel way to develop a simplified mathematical description of two practical nonlinear dynamic mechanical systems experiencing excitation similar to that due to an earthquake. This method is used to obtain system descriptions in closed algebraic form with appropriate constants. The number of constants provides the designer with the minimum number of complex time-history analyses (or tests) required to characterize the systems completely. Once these constants are evaluated, parametric and optimization studies can be performed very quickly by hand. Predictions based on application of the method are made. Comparison of these predictions to results obtained from time-history solutions show the method is a valuable design tool. Application of the method to other systems is briefly discussed. 6 figures, 4 tables.

RELATIVITY AND GRAVITATION

39959 Comment on a "New test of the synchronization procedure in noninertial systems". Lichtenberg, D.B.; Newton, R.G. (Physics Department, Indiana University, Bloomington, Indiana 47401). *Phys. Rev., D;* **19**: No. 4, 1268-1270(15 Feb 1979).

A proposed test of the synchronization of very closely spaced clocks, which was obtained in a recent paper using general relativity, is derived using special relativity only and generalized to the case of large separation between the clocks. It is pointed out that an equivalent test was performed by Sagnac in 1915, with results in agreement with the theory.

OPTICS

39960 (UCID—18030) **X-ray reflectivity vs mirror surface quality.** Stoering, J.P.; Rice, M.; Burginyon, G.A.; Crabb, R.; Augusta, E.L.; Wang, C.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1979. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

In an attempt to correlate x ray reflectivity with carbon mirror surface quality the relative reflectivity of five mirrors of different smoothness and optical flatness is compared. Measured and theoretical reflectivity values are in agreement for mirror smoothness <30 A and optical flatness <1000 A. Other correlation could not be established. 4 references.

STATISTICAL PHYSICS AND THERMODYNAMICS

39961 Scaled Boltzmann theory for k-dependent test particle correlation functions in moderately dense gases). Chen, S.; Rahman, A. (Nuclear Engineering Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Chem. Phys.;* **70**: No. 8, 3730-3738(15 Apr 1979).

Applicability of the hard sphere Boltzmann—Lorentz—Enskog test particle kinetic equation to the study of self-diffusion in moderately dense gases is assessed by comparing the numerical solutions of the equation for the velocity autocorrelation function, the kinetic energy autocorrelation function and the k-dependent test particle position correlation function with data generated from computer molecular dynamics and also with an incoherent quasielastic neutron scattering experiment. In order to adapt the hard sphere theory to explain data generated from systems in which particles interact via continuous potentials, the following procedure has been tested: We fix the effective collision frequency in the hard sphere kinetic equation by using the experimentally measured value of the self-diffusion coefficient. The results of the comparison show that this "scaled Boltzmann theory" compares well with the data for a system with a purely repulsive potential up to fairly high densities; however, increasing deviations are noticeable for a system in which the attractive part of the potential is included. This is so, especially at lower temperatures.

ELECTRICITY AND MAGNETISM

39962 (UCRL—52667) **Inversion of one-dimensional scattering data using Prony's method.** Miller, E.K.; Lager, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Feb 1979. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

A one-dimensional configuration is the simplest geometry to invert, yet it has practical application to such problems as scattering from inhomogeneous half-spaces and propagation on nonuniform transmission lines. Whether the medium parameters vary continuously or discretely with position, the problem's numerical description can usually be developed in finite-difference approximation. As such, the scattered and transmitted fields can be represented as exponential

series, whose exponents are related to the electrical thicknesses of the layers which make up the model. If the exponents or poles are derivable from field data, then the inverse problem is formally solvable. This report considers application of Prony's method, a procedure for obtaining the poles of exponential signals, to such one dimensional problems. Both time-domain and frequency-domain data are analyzed. The effects of the medium characteristics, number of layers, and other factors are examined. It is concluded that Prony's method has merit for certain classes of one-dimensional inverse problems. 8 figures, 1 table.

MATHEMATICAL PHYSICS

39963 (N—78-30886) **Gaps in the essential spectra of Schroedinger and Dirac operators.** Harris, B.J. (Loughborough Univ. of Technology (UK). Dept. of Mathematics). Nov 1977. 25p. NTIS PC A02/MF A01.

A systematic method of estimating the length of gaps in the essential spectrum of a self-adjoint operator generated by an ordinary differential system was investigated. It is shown how the same techniques may be employed to estimate the length of gaps in the essential spectra of Dirac and Schroedinger operators. Means of adapting this method in order to obtain the results deduced by Eastham for a self-adjoint operator generated by a second-order scalar differential equation were investigated.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

39964 (N—78-27916) **Radio-frequency plugging of a high density plasma.** Watari, T.; Hatori, T.; Kumazawa, R.; Hidekuma, S.; Aoki, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1978. 27p. NTIS PC A03/MF A01.

Mirror end loss can be suppressed by applying an RF field at the mirror throat through low impedance coils. This method is verified to be effective for a high density plasma up to 10 to the 14th power/cu cm. Experimental results show that the RF field strength required for the plugging is differently dependent on the plasma density according to the type of coil. The mechanism of giving the density dependence is theoretically clarified for each coil. The electric field induced in the direction of the static magnetic field is shown to be intrinsic for the density independent result of type 3 coil.

39965 (N—78-27917) **Plasma flow driven by fusion-generated alpha particles.** Ikuta, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1978. 11p. NTIS PC A02/MF A01.

The confinement of fusion-generated alpha particles will affect the transports of the background plasma particles by the momentum transfer from the energetic alphas. The ions tend to migrate towards the center of plasma (i.e. fuel injection) and electrons towards the plasma periphery. This indicates the existence of a mechanism which pumps out the ashes in the fuel plasma because of the momentum conservation of whole plasma particles.

39966 (UWFDM—227) **Fast magnetosonic wave heating of the NUWMAK tokamak reactor.** Scharer, J.E.; Blackfield, D.T.; Beyer, J.B.; Mau, T.K. (Wisconsin Univ., Madison (USA)). Jun 1978. Contract ET-78-C-02-4710. 141p. Dep. NTIS, PC A07/MF A01.

Studies are presented of radiofrequency (RF) coupling and heating to ignition of a conceptual tokamak fusion reactor by means of the fast magnetosonic wave at the second ion cyclotron harmonic. first, the current status of fast magnetosonic wave propagation and heating, mode conversion, and eigenmode theory is briefly reviewed. Next, a space-averaged, time-dependent startup model is used to describe the role of RF heating for ignition of a tokamak reactor.

39967 **Equilibria of diffuse high beta stellarators.** Freidberg, J.P.; Dagazian, R.Y.; Barnes, D.C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **22**: No. 5, 926-939(May 1979).

The ideal magnetohydrodynamic equilibrium of a diffuse high-β stellarator is investigated by an asymptotic expansion in the inverse aspect ratio. The basic new feature of the calculation is that the lowest order flux surfaces are assumed noncircular and noncon-centric. Equilibria are found for a wide range of experimentally interesting parameters. Finally, the connection of the high-β expansion with the low-β stellarator expansion is discussed in detail.

39968 **Theory of electron energy confinement in tokamaks.** Manheimer, W.M.; Antonsen, T.M. Jr. (Naval Research Laboratory, Washington, D. C. 20375). *Phys. Fluids;* **22**: No. 5, 957-970(May 1979).

A one-dimensional thermal transport code has been employed to study electron energy confinement in tokamaks. At each time step of the computations, each point in the profile is examined to determine whether it is linearly stable to either the dissipative trapped electron mode or the internal kink and tearing modes. If the point is determined to be unstable, an anomalously large electron thermal conductivity is turned on in the vicinity of that point. The electron temperature profile is found to relax to a marginally stable state. Our code predicts the scaling of confinement time with density in Alcator, and the scaling of temperature half-width with q (a) in Tokamak Fontenay aux Roses.

39969 **Maximum energy-confinement time in Joule-heated tokamaks.** Waltz, R.E.; Guest, G.E. (General Atomic Company, San Diego, California 92138). *Phys. Rev. Lett.;* **42**: No. 10, 651-655(5 Mar 1979).

Measurements of the energy confinement time tau/sub E/ in the ISX-A (Impurity Study Experiment) tokamak are interpreted theoretically using a one-dimensional time-dependent transport code. The maximum tau/sub E/ observed as the plasma density is varied over a wide range occurs at that density above which anomalous electron thermal conductivity leads to a smaller energy flux than neoclassical ion thermal conductivity.

39970 **Plasma confinement studies in the ISX-A tokamak.** Murakami, M.; Neilson, G.H.; Howe, H.C.; Jernigan, T.C.; Bates, S.C.; Bush, C.E.; Colchin, R.J.; Dunlap, J.L.; Edmonds, P.H.; Hill, K.W.; Isler, R.C.; Ketterer, H.E.; King, P.W.; McNeill, D.W.; Mihalczo, J.T.; Neidigh, R.V.; Pare, V.K.; Saltmarsh, M.J.; Wilgen, J.B.; Zurro, B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **42**: No. 10, 655-658(5 Mar 1979).

Gross-energy-confinement times (tau/sub E/) in the ISX-A (Impurity Study Experiment) tokamak exceeded predictions of the usual empirical scaling relations. We attribute this performance to reductions of impurity radiation and magnetohydrodynamically driven loss channels. The value of tau/sub E/ reached a limit as a function of plasma density. We suggest that this limit is due to a transition from electron- to ion-dominated loss regimes. Maximum attainable values of tau/sub E/ increased with discharge current, in agreement with this interpretation.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 40014

39971 (COO—2456-76) **High-beta tokamak research. Quarterly status report, 1 October—31 December 1978.** Stone, P. (Columbia Univ., New York (USA)). 22 Dec 1978. Contract EY-76-S-02-2456. 5p. Dep. NTIS, PC A02/MF A01.

Research activity on the Torus 1 and Torus 2 projects is summarized. The diagnostic system for Torus 2 is briefly discussed.

39972 (INIS-mf—4403) **High-temperature plasma diagnostics.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1977. 101p. (In Russian). (CONF-770954—(Summ.)). Dep. NTIS (US Sales Only), PC A06/MF A01.

From 2. conference on hot plasma diagnostics; Kharkov, USSR (22 Sep 1977).

Abstracts for each paper were entered into the data base.

39973 (PPPL—1538) **Dielectronic satellite spectrum of helium-like iron (Fe XXV).** Bitter, M.; Hill, K.W.; Sauthoff, N.R.; Efthimion, P.C.; Meservey, E.; Roney, W.; von Goeler, S.; Horton, R.; Goldman, M.; Stodiek, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 20p. Dep. NTIS, PC A02/MF A01.

Dielectronic satellite spectra of Fe XXV near 1.8500 A have been observed from PLT (Princeton Large Torus) tokamak plasma discharges for electron temperatures in the range from 1.5 to 3 keV and an electron density of 2×10^{13} cm^{-3}. The electron temperature was independently determined from the electron cyclotron radiation emitted by the plasma. The quality of the spectra allows a detailed comparison with theoretical prediction, which is of importance in view of diagnostic applications.

39974 (UCID—18089) **Computer language evaluation for MFTF SCDS.** Anderson, R.E.; McGoldrick, P.R.; Wyman, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1979. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

The computer languages available for the systems and application implementation on the Supervisory Control and Diagnostics System (SCDS) for the Mirror Fusion Test Facility (MFTF) were surveyed and evaluated. Four language processors, CAL (Common

Assembly Language), Extended FORTRAN, CORAL 66, and Sequential Pascal (SPASCAL, a subset of Concurrent Pascal [CPASCAL]) are commercially available for the Interdata 7/32 and 8/32 computers that constitute the SCDS. Of these, the Sequential Pascal available from Kansas State University appears best for the job in terms of minimizing the implementation time, debugging time, and maintenance time. This improvement in programming productivity is due to the availability of a high-level, block-structured language that includes many compile-time and run-time checks to detect errors. In addition, the advanced data-types in language allow easy description of the program variables. 1 table.

39975 Diagnosis of high-temperature hydrogen plasma by the resonance fluorescence method. Burakov, V.S.; Misakov, P.Y.; Naumenkov, P.A.; Nechaev, S.V.; Razdobarin, G.T.; Semenov, V.V.; Sokolova, L.V.; Folomkin, I.P. *Zh. Prikl. Spektrosk.;* **29**: No. 6, 1079-1087(Dec 1978). (In Russian).

The resonance fluorescence method is used for diagnostic high-temperature plasma in an <<Tokamak FT-1>> unit. Fluorescence on the wavelength H/sub α/ (λ = 656.3 nm) was excited by a dye laser with lamp pumping. According to the measured magnitude and the length of the fluorescence signal, the concentration of neutral hydrogen atoms (N_1) and excited (N_2 and N_3) atoms is calculated with an accuracy of not less than 10% at different moments of time of the discharge, and the distribution of neutral and excited hydrogen atoms over the radius of the chamber is investigated. Measurements are made in standard discharge conditions of the <<Tokamak FT-1>>, pressure of hydrogen in the chamber was 2.10^{-4} for, magnetic field intensity 75 kOe, discharge current 27 kA, T/sub e/ = 300 eV. At the peak of the current pulse on the discharge axis $N_1 \simeq 4.5 \times 10^8$ cm^{-3}.

PLASMA KINETICS - GENERAL

39976 (N—78-28954) Experimental and theoretical activities in plasma physics. Annual status report, 31 December 1976. (FOM-Instituut voor Plasmafysica, Jutphaas (Netherlands)). Jul 1977. 92p. NTIS PC A05/MF A01.

Some aspects of toroidal magnetic confinement systems for fusion plasmas are dealt with. They include screw-pinch devices, turbulent heating experiment, gas blanket studies, and work on magnetohydrodynamics and transport theory.

39977 Neutron emission profiles in the beam-heated Princeton large tokamak. Strachan, J.D.; Bhattacharjee, A.; Jassby, D.L.; Towner, H.H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Phys. Lett., A;* **66**: No. 4, 295-298(29 May 1978).

Neutron emission profiles in neutral-beam-heated deuterium plasmas in the PLT are strongly peaked on the magnetic axis, as expected for thermonuclear reactions during hydrogen beam injection, and for beam-target and beam-beam reactions during deuterium beam injection.

PLASMA KINETICS - EXPERIMENTAL

39978 (COO—4257-3) Development and testing of a three-stage double tandem accelerator-decelerator system for low energy, highly stripped ions. Progress report, March 1, 1978—February 28, 1979. Bayfield, J.E. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Nov 1978. Contract EG-77-S-02-4257. 36p. Dep. NTIS, PC A03/MF A01.

Three-stage operation of the University of Pittsburgh accel-decel double tandem source of highly stripped ion beams is described. The system has produced 0^{6+}, 0^{6+}, 0^{7+}, and 0^{8+} ions at specific energies as low as 15 keV per AMU. The design of the new decelerator tubes is discussed. The present performance and limitations of the overall system are outlined. Some new charge exchange cross sections have been measured, for combined higher ion charge states and lower ion energies than heretofore was possible. Future four-stage operation with very heavy ions is considered.

39979 (ORNL/TM—6823) Charge exchange measurements on ISX-A. Neilson, G.H. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

Apparatus and techniques for charge exchange neutral analysis on the ISX-A (Impurity Study Experiment) tokamak are described. A new neutral analyzer incorporating mass-energy resolution was constructed and calibrated for use on ISX. Data interpretation methods which account for profile effects and neutral attenuation have also been developed and were applied to data from the mass-energy analyzer. Examples of data from ISX-A are presented to illustrate both the use of this new instrument and the applicability of the described interpretation techniques.

39980 (PPPL—1534) Effect of current profile evolution on plasma-limiter interaction and the energy confinement time. Hawryluk, R.J.; Bol, K.; Bretz, N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 34p. Dep. NTIS, PC A03/MF A01.

Experiments conducted on the PLT tokamak have shown that both plasma-limiter interaction and the gross energy confinement time are functions of the gas influx during the discharge. By suitably controlling the gas influx, it is possible to contract the current channel, decrease impurity radiation from the core of the discharge, and increase the gross energy confinement time, whether the aperture limiters were of tungsten, stainless steel or carbon.

39981 (UCRL—82272) LLL dynamic high pressure experiments. Nellis, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

The Lawrence Livermore Laboratory has several experimental facilities to measure material properties at dynamic high pressures. These include an isobaric expansion experiment, a two-stage light-gas gun, and a high-power laser facility (Janus). Each of these are briefly described.

PLASMA KINETICS - THEORETICAL

39982 Anomalous alpha-particle transport in thermonuclear tokamak plasma. Sigmar, D.J.; Chan, H.C. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* **18**: No. 11, 1569-1581(1978).

Because of the strong localization of the fusion-born alpha particles in velocity and configuration space and their coupling to Alfven waves in the background plasma, the relaxation of alphas is anomalous. In a finite system, the enhanced electromagnetic fluctuations can produce rapid spatial losses of alpha population and energy. These losses prevent the alpha velocity distribution from attaining a stable collisional equilibrium, thus maintaining a steady-state turbulence level. A self-consistent numerical quasi-linear calculation is performed for one of the most dominant low-frequency modes, showing the evolution of the alpha distribution and yielding the anomalous loss rates.

39983 Spectral variance estimation and the analysis of turbulence data. Helland, K.N.; Rosenblatt, M. (Department of Applied Mechanics and Engineering Sciences, University of California, San Diego, La Jolla, California 92093). *Phys. Fluids;* **22**: No. 5, 819-823(May 1979).

The results of an asymptotic analysis for the variance of power spectra and the real and imaginary parts of complex cross spectra are presented. The formulae for the spectral variances do not require an assumption of jointly Gaussian probability density functions for the time series and, therefore, are of special importance to the analysis of turbulence data. The variances computed from the asymptotic formulae compare favorably with directly estimated variances for power spectra and a third-order cross spectrum which appear in the study of spectral energy transfer in turbulent flows. The asymptotic variance formulae can be useful tools for the design of experiments which require estimation of power and cross spectra.

39984 Astron type equilibrium in the absence of an applied magnetic field. Kapetanakos, C.A. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Fluids;* **22**: No. 5, 1004-1005(May 1979).

It is shown that the Vlasov—Maxwell equations predict the existence of rotating layer equilibria (rigid-rotor) in the absence of an external magnetic field, provided that the density of the layer exceeds a critical density.

PLASMA PRODUCTION

39985 (AD-A—059877) Emission of energetic electrons from a Nd-laser-produced plasma. Interim report. Armstrong, C.M.; Ripin, B.H.; Young, F.C.; Decoster, R.; Whitlock, R.R. (Naval Research Lab., Washington, DC (USA)). Aug 1978. 24p. NTIS PC A02/MF A01.

Absolute spectral measurements of 50-500 keV electrons emitted from a Nd-laser-produced plasma are presented. For normally incident irradiation (10 to the 15th power to 10 to the 16th power W/sq.cm.) onto polystyrene slab targets a total emission of about 10 to the 10th power electrons is inferred with a total emitted energy of about 0.2 mJ. The electron emission is observed to be almost the same both in and out of the plane of polarization. Properties of the emitted spectrum, such as spectral hardness and intensity are observed to be dependent on pulse shape and target material. (Author)

39986 Absorption of laser radiation by a dense expanding plasma. Polyanichev, A.N. (Engineering-Physics Institute, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 12, 1439-1443(Dec 1978).

Expressions are obtained for the time dependence of the optical reflection coefficient of a laser-produced plasma. The region where the parametric absorption mechanism (resulting from the parametric-decay instability $t \rightarrow l + s$) influences the hydrodynamic parameters of the expanding plasma is defined. The effects of ioniza-

tion and recombination on the reflection of laser radiation are considered.

PLASMA INSTABILITIES

39987 (N—78-28941) **High frequency stability of field-reversed ion rings in a background plasma.** Ludwig, G.O.; Sudan, R.N. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1978. 56p. NTIS PC A03/MF A01.

It is found that a background plasma subjected to the nonuniform magnetic field configuration produced by an ion ring supports short wavelength, electrostatic, flute-type normal modes at frequencies above the ion plasma frequency. These modes can be destabilized by the interaction with the energetic ions of the ring.

39988 **Nonlinear development of an electromagnetic filamentation instability.** Montgomery, D.; Liu, C.S. (University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **22**: No. 5, 866-870(May 1979).

A simplified model of an electromagnetic filamentation instability that arises when two counterstreaming electron beams pass through a uniform ion background is treated by statistical mechanical techniques borrowed from fluid turbulence theory. Accumulation of magnetic energy at long wavelengths is predicted, as observed in the numerical simulations of Lee and Lampe.

39989 **Stable equilibrium statistical states for spheromaks.** Vahala, G.; Vahala, L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Fluids;* **22**: No. 5, 871-873(May 1979).

Incompressible nondissipative magnetohydrodynamic turbulence is treated for spherical systems. From the absolute equilibrium expectation values of the fields one can investigate those initially quiescent states for which no large mean square velocity will develop. This stable state is force-free and gives rise to the Hill vortex structure for the magnetic flux surfaces.

39990 **Stability properties of an anisotropic guiding center plasma and relation with the Suydam function.** Choe, J.Y.; Davidson, R.C. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Phys. Fluids;* **22**: No. 5, 882-888(May 1979).

The effect of pressure anisotropy on the equilibrium and stability properties of an unstable guiding center plasma and the dependence of associated stability properties on the Suydam function S are examined. An explicit solution of the guiding center plasma equilibrium equation is obtained as a function of the anitsotropy parameter αequivalentP/sub parallel//P/sub perpendicular/ (assumed constant), and the maximum growth rates for internal kink modes are numerically computed for the entire permissible range of α. For a typical tokamak field configuration with shear in straight cylindrical geometry, it is found that the maximum growth rate is a monotonically increasing function of α. A detailed parameter study of equilibrium and stability properties is presented. The dependence of stability properties on the Suydam function S is investigated by correlating maximum growth rates with the magnitude of S, and by examining the ratio of consecutive eigenvalues for each set of the parameters. The numerical analysis shows that, even though the Suydam function occurs naturally in studies of marginal stability, the maximum growth rate (except for a narrow range of α) is a monotonically decreasing function of S.

39991 **Twisting modes.** Strauss, H.R.; Hazeltine, R.D.; Mahajan, S.M.; Ross, D.W. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). *Phys. Fluids;* **22**: No. 5, 889-895(May 1979).

New electromagnetic modes with odd magnetic field parity, the twisting modes, are described. These are closely related to the m=1 tearing modes, but are much more localized and are not restricted in azimuthal mode number. Unstable modes are found in the hydrodynamic and adiabatic electron dynamical regimes.

39992 **Nonlinear interaction of tearing modes in highly resistive tokamaks.** Waddell, B.V.; Carreras, B.; Hicks, H.R.; Holmes, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Fluids;* **22**: No. 5, 896-910(May 1979).

A mechanism for the major disruption in tokamaks is proposed involving the nonlinear destabilization of tearing modes by the m=2, n=1 tearing mode. A three-dimensional cylindrical nonlinear code based on a set of equations valid in the limit of low β and large ratio of the toroidal and poloidal magnetic fields has been constructed. The essential result is that for safety factor profiles flat in the plasma core the 2/1 mode significantly destabilizes other modes, particularly odd modes such as the 3/2 mode, before the 2/1 island in the single-pitch limit has expanded to its maximum width. Many magnetic islands of different pitch are produced and the corresponding deformation of the toroidal current density is more severe than in the two-dimensional case. The magnetic islands generated can extend across the plasma cross section; presumably, the corresponding ergodic magnetic fields can result in the escape of particles and heat from the plasma core. An analytic model in agreement with these results is also presented.

39993 **Finite beta effects on the drift-cyclotron instability.** Gladd, N.T.; Huba, J.D. (University of Maryland, Department of Physics and Astronomy, College Park, Maryland 20742). *Phys. Fluids;* **22**: No. 5, 911-922(May 1979).

The local dispersion equation for the drift-cyclotron instability is derived and solved in order to examine the effects of finite beta associated with (a) transverse electromagnetic perturbations (δBnot =0), and (b) resonant and nonresonant delB orbit modifications of both electrons and ions. Moreover, a formalism is chosen which allows consideration of variable density gradients, (m/sub e//m/sub i/)/sup 1/2/< or ≃r/sub L/i/L/sub N/< or ≃1, on the ions. A detailed numerical study of the effects of finite beta on the general dispersive character and unstable spectrum is presented as well as a consideration of the effects of finite beta on the most rapidly growing mode. It is found that finite beta, in general, increases the frequency and reduces the growth rate but does not completely stabilize the drift-cyclotron instability. The transition of the drift-cyclotron instability into the lower-hybrid-drift instability which occurs for r/sub L/i/L/sub N/≃ (m/sub e//m/sub i/)/sup 1/4/ is also discussed.

39994 **Raman side-scatter instability in nonuniform plasma.** Mostrom, M.A.; Kaufman, A.N. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **42**: No. 10, 644-647(5 Mar 1979).

For the Raman instability in nonuniform plasma, the linear space-time asymptotic response consists of two parts, convectively growing wave packets and temporally growing localized side-scattered eigenmodes. Eigenmodes dominate the response only after the growth of the side-scattered wave packets is terminated by refraction from their resonance zones. A finite pump-beam diameter typically ends all growth before eigenmodes appear, except near quarter-critical density. These considerations may reconcile simulations, previous theories, and experiments.

39995 **Turbulent destabilization and saturation of the universal drift mode in a sheared magnetic field.** Hirshman, S.P.; Molvig, K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **42**: No. 10, 648-651(5 Mar 1979).

In a sheared magnetic field, turbulent diffusion of electrons in the vicinity of a mode rational surface can eliminate the stabilizing influence of nonresonant electrons and lead to an absolute instability at small but nonzero wave amplitudes. As the turbulence grows, the inverse electron Landau resonance is broadened in both velocity and configuration space, and the convective shear damping due to ions is enhanced by turbulent spatial broadening of the mode until saturation occurs.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 39966

39996 (N—78-27915) **A new treatment of localized modes in inhomogeneous Vlasov plasma.** Watanabe, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1978. 15p. NTIS PC A02/MF A01.

An eigenmode analysis is established in plasma with arbitrary density profile. Finite Larmor effect is taken into account even if K sub x rho is greater than 1. Eigenfrequencies are determined through a compact quantization condition.

39997 (N—78-30944) **Low-frequency fluctuation spectra and associated particle transport in the NASA Lewis Bumpy-Torus plasma.** Singh, C.M.; Krawczonek, W.M.; Roth, J.R.; Hong, J.Y.; Kim, Y.C. (National Aeronautics and Space Administration, Cambridge, MA (USA). Electronics Research Center). Aug 1978. 53p. NTIS PC A04/MF A01.

The strong radial electric field associated with the Penning discharge and the strong toroidal magnetic field give rise to a diversity of E/B phenomena, such as rotating waves and spokes, which in turn manifest themselves as space-time fluctuations of the plasma density and potential. Work is done to further understand the nature and origin of the fluctuations and their connection with fluctuation-induced transport. The approach is to monitor the density and potential fluctuations; to digitize the data; and to generate, with the aid of a computer, various spectral properties by means of the fast fourier transform. Of particular interest is the computer-generated transport spectrum that indicates in a quantitative way which fluctuation spectral components contribute to transport and which do not. All experimental measurements of the spectral characteristics of the plasma are given in absolute units rather than as relative values. Preliminary measurements of the transport spectrum of the ion population are given, and it is shown that the fluctuation-induced transport is in order-of-magnitude agreement with that

inferred from the steady state current flowing to the electrodes that generate the plasma.

39998 **Damped double solitons in the nonlinear Schroedinger equation.** Pereira, N.R.; Chu, F.Y.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Fluids;* 22: No. 5, 874-881(May 1979).

The nonlinear Schroedinger equation modified by a damping term is investigated numerically for initial conditions other than single solitons. With damping, colliding solitons still pass through each other, but the breather can change qualitatively into two continuously interacting but separated solitons. These results are consistent with a slow change in the inverse scattering eigenvalues due to the damping.

39999 **Nonlinear evolution of lower hybrid waves.** Karney, C.F.F.; Sen, A.; Chu, F.Y.F. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Phys. Fluids;* 22: No. 5, 940-952(May 1979).

The two-dimensional steady-state distribution of lower hybrid waves is governed by the complex modified Korteweg—deVries equation, v/sub tau/+v/sub xixixi/+(vertical-barvvertical-bar^{2}v)/sub xi/=0, where v is proportional to the electric field and ξ and tau are two spatial coordinates. The equation is studied numerically. Two types of solitary waves can arise; one is a constant phase pulse, whereas the other is an envelope solitary wave. These solitary waves are not solitons. The occurrence of the constant phase pulses points to the possibility of internal reflections due to scattering off ponderomotive density fluctuations. This necessitates solving the equation as a boundary value problem. With typical fields for lower hybrid heating of a tokamak, it is found that large reflections can occur close to the edge of the plasma.

40000 **Interpretation of the ponderomotive potential for a magnetized particle in a low-frequency wave.** Cary), J.R.; Hammer, J.H. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Fluids;* 22: No. 5, 1003(May 1979).

One term in the expression for the ponderomotive potential of a low-frequency magnetoplasma wave has a simple interpretation: It is the parallel-electric-field potential produced directly by the wave.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 38942

40001 (LA—7686-MS) **Conceptual design of the Fast-Liner Reactor (FLR) for fusion power.** Moses, R.W.; Krakowski, R.A.; Miller, R.L. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 128p. Dep. NTIS, PC A07/MF A01.

The generation of fusion power from the Fast-Liner Reactor (FLR) concept envisages the implosion of a thin (3-mm) metallic cylinder (0.2-m radius by 0.2-m length) onto a preinjected plasma. This plasma would be heated to thermonuclear temperatures by adiabatic compression, pressure confinement would be provided by the liner inertia, and thermal insulation of the wall-confined plasma would be established by an embedded azimuthal magnetic field. A 2- to 3-mu s burn would follow the $\sim 10^4$ m/s radial implosion and would result in a thermonuclear yield equal to 10 to 15 times the energy initially invested into the liner kinetic energy. For implosions occurring once every 10 s a gross thermal power of 430 MWt would be generated. The results of a comprehensive systems study of both physics and technology (economics) optima are presented. Despite unresolved problems associated with both the physics and technology of the FLR, a conceptual power plant design is presented.

40002 (UCID—18156) **Improved tandem mirror fusion reactor.** Baldwin, D.E.; Logan, B.G.; Fowler, T.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 45p. Dep. NTIS, PC A03/MF A01.

An improved version of the tandem mirror fusion reactor is presented in which a power gain factor Q $\sim$ 10 to 20 can be obtained at a few 100 MWe electrical output with much simpler technology in the end plugs. The improvement is obtained by raising the electron temperature in the end plugs well above that in the central cell (which would be ignited). The heating power required to maintain the high electron temperature is greatly reduced - to 20 to 40 MW per plug - by creating negative depressions in the potential that serve to thermally insulate electrons in the end plugs from those in the central cell. The overall concept and several proposed methods for creating the thermal barriers are discussed. A reactor example is then discussed.

40003 (INIS-mf—4125) **Controlled fusion and plasma physics. Vol. II.** (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). [nd]. 272p. (CONF-770906—P2). Dep. NTIS (US Sales Only), PC A13/MF A01.

From 8. European conference on controlled fusion and plasma physics; Prague, Czechoslovakia (19 Sep 1977).

Separate abstracts for each paper were entered into the data base. (MOW)

40004 (INIS-mf—4324) **Controlled fusion and plasma physics. Workshop on stellarators.** (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). [nd]. 42p. (CONF-7709174—(Summ.)). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 8. European conference on controlled fusion and plasma physics; Zdikov, Czechoslovakia (26 Sep 1977).

Separate abstracts were entered into the data base for each paper. (MOW)

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 38724

40005 (BNL-NUREG—25635) **One- and two-dimensional heating analyses of fusion synfuel blankets.** Tsang, J.S.K.; Lazareth, O.W.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790602—14). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Comparisons between one- and two-dimensional neutronics and heating analyses were performed on a Brookhaven designed fusion reactor blanket featuring synthetic fuel production. In this two temperature region blanket design, the structural shell is stainless steel. The interior of the module is a packed ball of high temperature ceramic material. The low temperature shell and the high temperature ceramic interior are separately cooled. Process steam ($\sim$ 1500°C) is then produced in the ceramic core for the producion of H_2 and H_2-based synthetic fuels by a high temperature electrolysis (HTE) process.

40006 (PPPL—1537) **Hydrogen isotope trapping in materials exposed in PLT.** Wampler, W.R.; Picraux, S.T.; Cohen, S.A.; Dylla, H.F.; McCracken, G.M.; Rossnagel, S.M.; Magee, C.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 9p. (CONF-790125—43). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Samples exposed at various minor radii in PLT to small numbers of high power discharges have been analyzed for the amount and depth distribution of implanted hydrogen isotopes and higher Z impurities. Comparisons of the measured H,D concentrations and depth profiles with laboratory implantations and calculated depth profiles give the energy and fluence of the hydrogen implanted in the PLT samples. For a Maxwellian distribution, characteristic temperatures of 500 to 600 eV due to plasma charge exchange, and 50 to 350 eV due to ions at the plasma edge are obtained. Also a 5 to 40 keV component is observed due to neutral beam injection.

40007 (UWFDM—288) **Tokamak reactors and structural materials.** Conn, R.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Jan 1979. Contract ET-78-S-02-4410. 10p. (CONF-790125—46). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

A summary is given of the status of the tokamak as a reactor concept and the relationship between first wall and blanket materials behavior and reactor design.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 39268, 39269, 39270

40008 (PPPL—1517) **Transient eddy currents on finite plane and toroidal conducting surfaces.** Weissenburger, D.W.; Christensen, U.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 61p. Dep. NTIS, PC A04/MF A01.

this report applies a previously presented mesh analysis method to calculate transient eddy currents in conducting surfaces. Example calculations are presented for a planar conducting sheet of finite dimensions and also for a toroidal conducting surface which represents the vacuum vessel of the TFTR. For the toroidal sheet, branch inductances are initially calculated by num erically integrating the vector potential function, then the branch matrix is transformed into a mesh matrix. For the flat sheet, an analytic expression is given which enables direct calculation of the mesh inductance matrix. Streamline plots of the eddy current distributions are shown at successive time steps for each example.

POWER SUPPLIES, ENERGY STORAGE

40009 (LA—7759-MS) **Tests of vacuum interrupters for the Tokamak Fusion Test Reactor.** Warren, R.; Parsons, M.; Honig, E.;

Lindsay, J. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 34p. Dep. NTIS, PC A03/MF A01.

The Tokamak Fusion Test Reactor (TFTR) project at Princeton University requires the insertion of a resistor in an excited ohmic-heating coil circuit to produce a plasma initiation pulse (PIP). It is expected that the maximum duty for the switching system will be an interruption of 24 kA with an associated recovery voltage of 25 kV. Vacuum interrupters were selected as the most economical means to satisfy these requirements. However, it was felt that some testing of available systems should be performed to determine their reliability under these conditions. Two interrupter systems were tested for over 1000 interruptions each at 24 kA and 25 kV. One system employed special Westinghouse type WL-33552 interrupters in a circuit designed by LASL. This circuit used a commercially available actuator and a minimum size counterpulse bank and saturable reactor. The other used Toshiba type VGB2-D20 interrupters actuated by a Toshiba mechanism in a Toshiba circuit using a larger counterpulse bank and saturable reactor.

COOLING SYSTEMS

40010 (ORNL/TM—6560) **Nuclear performance of molten salt fusion—fission symbiotic systems for catalyzed DD and DT reactors.** Ragheb, M.M.H.; Santoro, R.T.; Barnes, J.M.; Saltmarsh, M.J. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 43p. Dep. NTIS, PC A03/MF A01.

The nuclear performance of a fusion-fission hybrid reactor having a molten salt composed of Na-Th-F-Be as the blanket fertile material and operating with a catalyzed DD plasma is compared to a similar system utilizing a Li-Th-F-Be salt and operating with a DT plasma. The production of fissile fuel via the ^{232}Th-^{233}U fuel cycle was considered on the basis of its potential nonproliferation aspects. The calculations were performed using one-dimensional discrete ordinates methods to compare neutron balances, fuel producion rates, energy deposition rates, and the radiation damage in the reactor structure.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 40019

40011 Properties of an intense 40-kV neutral beam injector. Stirling, W.L.; Tsai, C.C.; Haselton, H.H.; Schechter, D.E.; Whealton, J.H.; Dagenhart, W.K.; Davis, R.C.; Gardner, W.L.; Kim, J.; Menon, M.M.; Ryan, P.M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Rev. Sci. Instrum.;* **50**: No. 5, 523-527(May 1979).

The properties of an intense neutral beam injector, the modified duoPIGatron ion source, are discussed and compared with other injectors. For this source (a) beam composition for hydrogen is ~ (85 +- 5) % monatomic, (b) nucleon gas efficiency is 50%, (c) the electrical efficiency of ion generation is 1.1 A/kW, and (d) up to 52% of the input power is delivered in the ion and neutral beam to a target subtending a half angle of $1.8^0 \times 1.4^0$.

40012 Experimental test of the feasibility of heating tokamaks by gun injection. Strait, E.J.; Sprott, J.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). *Nucl. Fusion;* **18**: No. 11, 1595-1598(1978).

The possibility of injecting a plasma beam into a pre-existing plasma confined by a magnetic field with rotational transform is demonstrated.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 38599

40013 (HEDL-SA—1594-FP) **Control of beryllium-7 in liquid lithium.** Anantatmula, R.P.; Brehm, W.F.; Baldwin, D.L.; Bevan, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1978. Contract EY-76-C-14-2170. 32p. (CONF-790125—41). Dep. NTIS, PC A03/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Radiation fields created by the production of ^7Be in lithium of the Fusion Materials Irradiation Test (FMIT) Facility can be sufficiently high to prevent contact maintenance of system components. Preliminary experiments have shown that ^7Be will adhere strongly to the FMIT piping and components and a good control method for ^7Be must be developed. The initial experiments have been conducted in static stainless steel capsules and a Modified Thermal Convection Loop (MTCL). The average lithium film thickness on stainless steel was found to be 11 μm in the temperature range 495^0 to 571^0K from the capsule experiments. The diffusion coefficient for ^7Be in stainless steel at 543^0K was calculated to be 5.31×10^{-15} cm^2/sec. The cold leg of the MTCL picked up much of the ^7Be activity released into the loop. The diffusion trap, located in the cold leg of the MTCL, was ineffective in removing ^7Be from lithium, at the very slow flow rates ($< 3.79 \times 10^{-4}$ m^3/s) used in the MTCL. Pure iron has been shown to be superior to coblat and nickel as a getter material for ^7Be.

INERTIAL CONFINEMENT TECHNOLOGY

40014 (UCRL—52521) **Electronics of the target diagnostics system for the Shiva Laser Fusion Facility.** Campbell, D.; Severyn, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jul 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

The organizing philosophy and components of a target diagnostics data acquisition system designed and implemented at the Lawrence Livermore Laboratory (LLL) Shiva Laser Fusion Facility are described. Several features of the system are unique: a central trigger distribution system, fiber optic communications, and fiber optics for the timing, trigger, and control and monitoring links. The system also uses CAMAC instrumentation, transient digitizers, oscilloscopes, and LLL-designed modules and packages, as well as single-point grounding of each diagnostic installation. Distributed instrumentation packages provide instrumentation flexibility and analog-to-digital conversion as close to each diagnostic sensor as practical.

40015 (UCRL—81896) **Laser-plasma coupling.** Kruer, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1978. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

The following topics are discribed: (1) ionization of target, (2) electromagnetic wave propagation in plasma, (3) collisional absorption, (4) light absorption in collisionless plasma, (5) resonance absorption, (6) instabilities, (7) Brillowin instability, and (8) some other effects. (MOW

40016 (UCRL—82120) **Lawrence Livermore Laboratory heavy ion fusion program.** Bangerter, R.O.; Lee, E.P.; Monsler, M.J.; Yu, S.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Dec 1978. Contract W-7405-ENG-48. 5p. Dep. NTIS, PC A02/MF A01.

In the large fusion program at Livermore we are actively doing research in most areas of inertial confinement fusion. The areas in which we are funded for research specific to heavy ion fusion are: (1) target design; (2) energy conversion chamber design and (3) ion beam propagation in the combustion chamber. There are two main thrusts to the target design effort: (1) development of targets which are optimally suited to heavy ion fusion power production and (2) fundamental studies of the beam-target interaction.

40017 Self-similar power-driven expansion into vacuum. Farnsworth, A.V. Jr.; Widner, M.M.; Clauser, M.J.; McDaniel, P.J.; Lonngren, K.E. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Fluids;* **22**: No. 5, 859-865(May 1979).

Planar, power-driven expansion into a vacuum is found to be self-similar for a power-law driving source for the two ideal cases of a thick slab and a thin foil. For the thick slab expansion, an asymptotic solution for the far-blowoff region is obtained and a numerical solution is present for the rest of the expansion wave. For the thin foil expansion, an analytical solution is obtained. In both cases, the solutions exhibit an unbounded flow field with velocities tending to infinity as a consequence of the continuum assumption, a finite temperature limit for the far-blowoff material, and density profiles that decrease as a Gaussian in the far expanded material.

40018 Magnetron sputter coating of microspherical substrates. Lowe, A.T.; Hosford, C.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Vac. Sci. Technol.;* **16**: No. 2, 197-199(Mar 1979).

The fabrication of laser fusion targets requires the deposition of various metal and dielectric layers on microspherical substrates (100—500 μm diameter). The continuous motion for uniformly coating these spherical substrates has been accomplished for rf sputtering applications. In one approach, the spheres being coated are bounced and laterally swept across a table as the frequency of vibration of the table is changed continously. In another approach, the sputtering gas is also a levitation gas. The argon is fed through a collimated hole structure and keeps the microsphere both levitated and rotating during the sputter deposition. The uniformity and surface quality of the deposited films obtained by these two techniques are compared.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 39254, 39781

40019 (LBL—8900) **Doublet III neutral beam source cryopanel system.** Tanabe, J.; Yamamoto, R.; Arend, P.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-

7405-ENG-48. 4p. (CONF-790327—98). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A cryogenic pumping system is designed to provide 1.4 x 10^6 l/sec. of hydrogen pumping speed for the Doublet III neutral beam ion source. The cryopump is made up of two elements; a cylindrical unit which uses a Santeler type of liquid nitrogen shield and a flat chevron shielded disk. Liquid helium and liquid nitrogen are circulated by forced flow. The liquid helium is circulated at 0.6 atm absolute pressure for cryopump operation at 3.8°K.

40020 (PPPL—1521) Measurements of sputtering yields for low-energy plasma ions. Nishi, M.; Yamada, M.; Suckewer, S.; Rosengaus, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 31p. Dep. NTIS, PC A03/MF A01.

Sputtering yields of various wall/limiter materials of fusion devices have been extensively measured in the relevant plasma environment for low-energy light ions (E < 300eV). As a plasma source we have used an energetic arc device (QED-1 machine) in which hydrogen, deuterium, helium and argon plasma can be generated with a density of up to 10^{14} cm^{-3} and electron temperature up to 10eV. Target materials used were C (graphite), Ti, Mo, Ta, W, and Fe (stainless steel). In order to study the dependence of the sputtering yields on the incident energy of ions, the target samples were held at negative bias voltage up to 300V. The sputtering yields were determined by a weight-loss method and by spectral line intensity measurements. The data obtained in the present experiment agree well with those previously obtained at the higher energies (E ≧ 200eV) by other authors using different schemes; the present data also extend to substantially lower energies (E ~ > 30eV) than hitherto.

40021 Shiva and Argus target diagnostics vacuum systems. Glaros, S.S.; Mayo, S.E.; Campbell, D.; Holeman, D. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Vac. Sci. Technol.;* **16**: No. 2, 674-680(Mar 1979).

In normal operation Lawrence Livermore Laboratory's Argus and Shiva laser irraddiation facilities demand a main vacuum system for the target chamber and a separate local vacuum system for each of the larger appendage diagnostics. This paper will describe the Argus and Shiva main vacuum systems, their respective auxiliary vacuum systems, and the individual diagnostics with their respective special vacuum requirements and subsequent vacuum systems. Our latest approach to automatic computer-controlled vacuum systems will be presented.

40022 Versatile UHV sample transfer system. Clausing, R.E.; Heatherly, L.; Emerson, L.C. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 708-710(Mar 1979).

A vacuum transfer system has been developed that allows samples to be inserted from air into an Auger analyzer. Following an initial analysis they may then be moved to and from a separate vacuum chamber for other studies. The system is constructed of standard UHV components and can be fabricated to cover any desired transfer distance. All-metal sealed valves isolate the various chambers so that the vacuum integrity of each is maintained. The sample size is limited only by the smallest constriction within the components, which is 2 cm in the system described. The transfer is rapid and is capable of being controlled remotely for use in a hostile environment.

40023 UHV compatibility of two possible fusion reactor materials: K-ramic/sup R/ and ATJ graphite. Moore, R. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08540). *J. Vac. Sci. Technol.;* **16**: No. 2, 748-751(Mar 1979).

Outgassing characteristics of K-ramic/sup R/ (manufactured by Kaman Nuclear) and ATJ graphite were evaluated under various treatments. For K-ramic, total outgassing rates of 2 x 10^{-9} Torr l s^{-1} cm^{-2} unbaked and 7 x 10^{-11} Torr l s^{-1} cm^{-2} baked were measured. Mass spectroscopic measurements showed H_2 and CO to be the dominant residual gases. For ATJ, graphite the treatment consisted of repeated heatings in vacuo to 1250 K as well as repeated exposures to atmosphere. Residual gas analysis measured the time dependence of desorbed quantities of H_2, H_2O, CO_2, CO, and CH_4. During the initial heating, the maximum species atom to lattice atom ratios were obtained yielding values of 2.6 x 10^{-6} for H_2, 3.4 x 10^{-5} for H_2O, 1.6 x 10^{-5} for CO_2, 7.6 x 10^{-6} for CO, and 5.2 x 10^{-6} for CH_4. The toalt outgassed material from the graphite sample decreased by a factor of 10^3 after successive heatings.

40024 Observations of changes in residual gas and surface composition with discharge cleaning in PLT. Dylla, H.F.; Bol, K.; Cohen, S.A.; Hawryluk, R.J.; Meservey, E.B.; Rossnagel, S.M. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08540). *J. Vac. Sci. Technol.;* **16**: No. 2, 752-757(Mar 1979).

Hydrogen discharge cleaning of the PLT vacuum vessel has been studied by mass spectroscopy of desorbed gases and surface analysis of exposed samples. Several modes of vessel conditioning have been studied to date: (1) a high-power discharge cleaning (PDC) mode, with a peak power density to the vessel wall P/sub s/ ~0.6 W/cm^2 and a peak electron temperature T/sub e/ ~100 eV; (2) low-power (Taylor-type) discharge cleaning (TDC) with P/sub s/ ~0.05 W/cm^2 and T/sub e/< or =5 eV. The predominant residual gases produced during PDC are CH_4 (1—5 x 10^{-6} Torr) and CO (1—10 x 10^{-7} Torr), whereas TDC produced primarily H_2O (1—2 x 10^{-6} Torr) and CH_4 (1-10 x 10^{-7} Torr). The transient behavior of the residual gases is not simply related to pumping time constants, and provides evidence for the role of surface chemical reactions and diffusion on the formation of these gases. In situ surface analysis of hydrocarbon-covered stainless steel has shown significant decreases in carbon coverage occurring after 10^3—10^4 pulses of either cleaning mode. Observed changes in oxygen coverage are more difficult to interpret because of the presence of the passivation oxide layer on the stainless-steel substrates.

40025 Ion and electron desorption of neutral molecules from stainless steel (304). Edwards, D. Jr. (Brookhaven National Laboratory, Upton, New York). *J. Vac. Sci. Technol.;* **16**: No. 2, 758-760(Mar 1979).

The vacuum performance of both electron and proton storage rings (as well as certain types of fusion reactors) is expected to be sensitive to the desorption of neutral molecules from the vacuum chamber wall by ~keV charged particles. In this study the desorption yields of H_2, CO, CO_2, and CH_4 are reported from 1000-eV Ar^+ and 500-eV e^- impacting on SS (304) samples (~ 1000 cm^2 surface area) prepared by: (i) a degrease treatment, (ii) an acid cleaning (1/3 HF, 1/3 HNO_3, 1/3 H_2O), (iii) concentrated HF. Three separate samples were analyzed for the first two treatments allowing the sample-to-sample variation to be determined (10%—20% yield variations). The unit yield energy E_0 (electron energy for which the total secondary electron emission is 1.0) has also been measured for each of the above treatments.

40026 Residual gas analysis in the ISX-A tokamak. Simpkins, J.E.; Colchin, R.J.; Overbey, D.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 763-765(Mar 1979).

A computer-controlled mass analyzer was utilized to observe the residual gases in the ISX-A tokamak. This residual gas analysis (RGA) system enabled time resolved measurements of preselected m/e peak heights to be made during and after tokamak discharges. Routine mass scans were also made and displayed in the form of semilogarithmic plots of partial pressure (Torr) versus m/e. Wall conditioning of the stainless steel torus consisted of hydrogen discharge cleaning and titanium gettering, which ultimately produced gauge pressures on the order of 10^{-8} and 10^{-9} Torr, respectively. The dominant plasma impurities, carbon and oxygen, were observed by the RGA as light hydrocarbons and water vapor. Entrapment of deuterium by the walls was investigated by monitoring the residual D_2 content after the working gas was changed to H_2. The effective nuclear charge (Z/sub eff/) was found to be proportional to the residual contaminants measured by the RGA immediately following a discharge.

40027 Surface impurity studies in the ISX-A tokamak. Emerson, L.C.; Clausing, R.E.; Heatherly, L. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Vac. Sci. Technol.;* **16**: No. 2, 766-768(Mar 1979).

The Impurity Study Experiment (ISX-A) was a tokamak designed to study impurity sources, plasma wall interactions, impurity behavior within the plasma, and related phenomena. An Auger electron spectrometer, attached to the tokamak by means of a UHV sample transfer system, has been the primary tool used for surface studies of the first wall. Stainless steel samples positioned at the wall edge were used to follow the progressive "cleanup" of the torus wall. Cleaning consisted of low energy hydrogen discharge plasmas, and later titanium gettering. The principal contaminants initially were carbon, oxygen, and sulfur. As cleaning proceeded, the surface oxide layers were reduced to substoichiometric levels, and the carbon deposits appeared to be converted to metallic carbides. The sulfur was largely removed. A decrease in the effective nuclear charge of the plasma could be correlated with these surface changes. Discharge cleaning reduced Z/sub eff/ from ~4 to 1.6 over a period of several months while titanium gettering produced values approaching 1.0.

GENERAL AND MISCELLANEOUS

40028 (N—78-31530) **Energy: A continuing bibliography with indexes, Issue 17.** (Alabama Univ., Huntsville (USA). Dept. of Physics). Apr 1978. 347p. NTIS PC E05.

This bibliography lists 1292 reports, articles, and other documents introduced into the NASA scientific and technical information system from January 1, 1978 through March 31, 1978.

MANAGEMENT

REFER ALSO TO CITATION(S) 40035

40029 (SAND—78-2242) **Sandia Laboratories education and training programs. Third annual report, 1977—1978.** (Sandia Labs., Albuquerque, NM (USA); Sandia Labs., Livermore, CA (USA)). Feb 1979. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

This third annual report, prepared by the Education and Training Departments at Sandia Laboratories (Albuquerque and Livermore), describes Sandia Laboratories' education and training programs for academic year 1977—1978. The educational programs offered are in keeping with Laboratories' policy to provide opportunities for employees to maintain their technical vitality and to improve their abilities to perform present or future duties. Some programs are Affirmative Action programs. In almost all programs, activity increased over the 1977 level, apparently in response to the expressed encouragement from management and the increased number of educational opportunities. Programs were classified as follows: in-hours technical courses, in-houses courses, one-year-on-campus, doctoral study program, Stanford University instructional television, educational aid program, university part-time, out-of-hours courses, self-study, technical institute equivalency, ESA trainee, work-study, management and staff training and management consulting, adjunct and sponsored professors, Associated Western Universities, MAS/MLS trainee, secretarial and clerical work/training and orientation, apprenticeship, Sandia/T-VI/CEC drafting program, and summer science. 36 figures, 2 tables. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 39974

40030 (COO—2280-37) **Probabilistic error analysis of computer arithmetics.** Bareiss, E.H.; Barlow, J.L. (Northwestern Univ., Evanston, IL (USA)). Dec 1978. Contract EY-76-S-02-2280. 102p. Dep. NTIS, PC A06/MF A01.

The problem of continuous and discrete error distribution for real computer arithmetics is discussed. The existing literature is surveyed. Several new and important theorems are proven. Results are illustrated with 9 figures and 14 tables.

40031 (COO—2383-0056) **Multirate ordinary differential equation intergrator.** Orailoglu, A. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Mar 1979. Contract EY-76-S-02-2383. 39p. (UILU-ENG—79-1704). Dep. NTIS, PC A03/MF A01.

Thesis.

Most of the work on the numerical integration of systems of ordinary differential equations concerns itself with integrating all the variables simultaneously. There has been little theoretical work on integrating the variables separately (multirate methods), and even less in implementing a multirate ordinary differential equation integrator. A multirate integrator is presented in this work, and different schemes are tested. The implemented multirate integrator is applied to a variety of test problems, and experimental results are plotted. These show the possibility of large efficiency gains in using multirate methods for a variety of systems of ordinary differential equations. 8 figures.

40032 (COO—3077-156) **Courant Mathematics and Computing Laboratory, New York University. Progress report No. 54, October 1, 1977—September 30, 1978.** (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). 1 Dec 1978. Contract EY-76-C-02-3077. 50p. Dep. NTIS, PC A03/MF A01.

Work is reported in the following areas: applied mathematics (computational fluid dynamics, numerical analysis), computational magnetohydrodynamics, computational physics and chemistry (materials science, quantum many-body systems, chemistry), computer science (CIMS PL/I, Version II; distributed systems and resource sharing, computer design - PUMA; SETL; algorithmic combinatorics), systems programing and user services. The relationship to other projects, list of seminars, and list of publications are also included. The research descriptions are administrative in nature, usually less than a page in length. (RWR)

40033 (DOE/EIA—0103/25) **Primer and user manual for a Fortran Language Interactive Processor (FLIP).** Greenburg, H.J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1979. 54p. Dep. NTIS, PC A04/MF A01.

A Fortran Language Interactive Processor (FLIP) was developed as a precursor for validation software under development, which will provide a capability for interactive diagnostic analysis of matrical models. As the routines are coded in Fortran, using IBM's G-compiler, FLIP is not fully portable. The purpose of FLIP is to provide a skeleton interactive system with complete user interface which enables a system designer to have a ready-made front end for an interactive system. Tasks such as parsing, bookkeeping, and providing help to the ultimate user are intrinsic in FLIP.

40034 (DOE/TIC—10096) **Implementation and testing of optimization software.** More, J.J. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

Optimization software must perform satisfactorily on a wide range of machines and compilers. This requirement demands that the development of the software must adhere to strict standards; the purpose of performance testing is to verify that the implementation of an algorithm satisfies these standards. It is necessary to test software at two levels: the robustness and reliability of the implementation, and the overall performance of the implementation. A robust implementation extends the domain of the algorithm so that it copes with as many problems as possible without a serious loss of efficiency. A reliable implementation performs well-defined calculations accurately and efficiently. The approach used at ANL to develop transportable optimzation software is outlined. Guidelines for the implementation of optimization software are suggested, and the (often dramatic) effect that these guidelines have on the performance of the implementation is shown. In addition, the weaknesses in the usual approaches to performance testing of optimization software are discussed and some remedies are suggested. (RWR)

40035 (K/CSD/TM—29) **Description of data entry for automated cost estimating.** Van Wie, N.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1979. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

A series of computer programs has been developed to aid the personnel of the UCC-ND Estimating Engineering Department in the computational and reporting phases of preparing a project cost estimate. These programs are operative on any project, regardless of scale, as long as a minimal set of rules for preparation of the data base is followed. The data base for a project is subdivided into four types of data or files: a title file, a front-end file, a file of cost sheets for the base cost estimate, and a file of cost items with their schedules for the time-phased estimate. It is the purpose of this document to describe the data requirements and formating specifications for preparation of these files so as to enable computation. Examples are presented and alternative approaches to accomplish an end result are explained. As opportunities have evolved over the time to extend the versatility of the computational tasks, simplification of data entry has resulted. 12 figures, 3 tables.

40036 (LA—7633-M) **EASYTBL: phototypeset tables for LASL reports.** Williams, J.M. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

This report shows how tables for informal, camera-ready reports can be generated with minimal typing. The procedure is designed especially to work on data files that will also be used as computer program inputs. Also discussed is how very wide tables with easily changed type sizes can be produced, and whited-out corrections, minimized. 16 tables.

40037 (LA—7677-MS) **Multiple-comparisons procedures. Informal report.** Conover, W.J.; Iman, R.L. (Los Alamos Scientific Lab., NM (USA)). Feb 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

Some of the more popular multiple-comparisons procedures are discussed and compared. Some new nonparametric methods are introduced. One procedure is an analog to the Fisher's least-significant-difference method for the completely randomized design. Some simulation studies indicate this procedure is a reasonable nonparametric method to use. A summary description is given for other nonparametric methods, which may be used with the completely randomized or randomized blocks designs. 3 tables.

40038 (LA—7700-MS) **Bivariate distributions with given marginals and fixed measures of dependence.** Johnson, M.E.; Tenenbein, A. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

P.

Two systematic approaches are given for constructing continuous bivariate distributions with specified marginals and fixed dependence measures. Both approaches are based on linear combina-

tions of independent random variables and result in bivariate distributions which can attain the Frechet bounds. The dependence measures considered are the grade correlation coefficient and Kendall's tau. The joint distributions obtained are compared to those of earlier authors. Applications to testing for sensitivity in simulation models are discussed. 8 tables.

40039 (LA-UR—78-2116) **Computer methods for sampling from the gamma distribution.** Johnson, M.E.; Tadikamalla, P.R. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 9p. (CONF-781213—2). Dep. NTIS, PC A02/MF A01.

From Winter simulation conference; Miami Beach, FL, USA (4 Dec 1978).

Considerable attention has recently been directed at developing ever faster algorithms for generating gamma random variates on digital computers. This paper surveys the current state of the art including the leading algorithms of Ahrens and Dieter, Atkinson, Cheng, Fishman, Marsaglia, Tadikamalla, and Wallace. General random variate generation techniques are explained with reference to these gamma algorithms. Computer simulation experiments on IBM and CDC computers are reported.

40040 (MHSMP—79-42) **Statistics for simplification.** Harris, C.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Apr 1979. Contract EY-76-C-04-0487. 13p. Dep. NTIS, PC A02/MF A01.

The usefulness and importance of statistics are discussed in a colloquial manner. Statistical studies require four steps: investigate the problem and list the questions to be answered; select the method of analysis; collect the data; make the computations and report the results. The presentation should be simple and not get bogged down in statistical terminology. Applications of statistics in measurement and control are mentioned. (RWR)

40041 (RFP—2902) **Rocky Flats experience with SDM/70.** Sanders, J.W. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 11p. (CONF-790431—1; CONF-790603—1). Dep. NTIS, PC A02/MF A01.

From 20. AESOP conference; Gatlinburg, TN, USA (24 Apr 1979).

SDM/70 is a comprehensive system for developing systems. It employs a series of phases designed for consistent, orderly progress through the entire system development life cycle, with heavy emphasis on interaction with the users in the early phases and straightforward, but thorough, documentation throughout. The overall package includes a standard structure of tasks and steps for each phase, methods guidelines, many good forms and tutorials on state-of-the-art techniques. It has guidelines for estimating costs and schedules, approaches for improving project management, and ways to match the effort to the size and type of project (even for small applications or maintenance and enhancement of existing systems). Reasons for adoption of a new methodology by the Computing and Information Systems Department at Rocky Flats are reviewed. The choice of SDM/70 is described, and the status after about a year's experience, including the benefits perceived during that time, is discussed. (RWR)

40042 (SAND—79-0458C) **Lipschitz constants and robust ODE codes.** Shampine, L.F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 32p. (CONF-790311—2). Dep. NTIS, PC A03/MF A01.

From 2. international conference on comp. meth. in nonlinear mech.; Austin, TX, USA (26 Mar 1979).

Estimates of local Lipschitz constants can be computed cheaply with Adams and Runge—Kutta methods. ODE codes can be made more robust with this information by helping the user know if his problem is correctly formulated, if he is using the right kind of method, and if the method is being applied in a reliable way.

40043 (SU—326-P30-61) **Extrapolation of asymptotic expansions by a modified Aitken δ^2-formula.** Bjorstad, P.; Dahlquist, G.; Grosse, E. (Stanford Univ., CA (USA). Dept. of Computer Science). Mar 1979. Contract EY-76-S-03-0326-030. 53p. (STAN-CS—79-719). Dep. NTIS, PC A04/MF A01.

A modified Aitken formula permits iterated extrapolations for efficient estimation of s/sub infinity/ from s/sub n/ when an asymptotic expansion s/sub n/ = s/sub infinity/ + n$^-$/sup k/($c_0 + c_1 n^{-1} + c_2 n^{-2} + \ldots$) holds for some (unknown) coefficients c/sub j/. Truncation and irregular errors are studied, and the method is compared with other forms of extrapolation. 3 figures.

40044 **Set-theoretic foundations of data-structure representation.** Hegner, S.J.; Maulucci, R.A. (Univ. of California, Livermore). *Inf. Syst.;* 193-201(1978).

A formal set-theoretic model for the computer representation of data is developed. The key idea of the model is the concept of the distinguished urelement. A Zermelo—Fraenkel set theory ZF is the starting point. This theory contains all the fundamental sets which are required. A new Zermelo—Fraenkel theory ZF' is then formed which is identical to ZF except that it contains an additional constant a, interpreted as a urelement. Working in ZF', new definitions for the usual constructions in mathematics (e.g., permutation, projection, join, composition) are developed for the elements in ZF. These definitions are far better suited for computer representations than are the usual definitions. In particular, the new definition of ordered n-tuple possesses a symmetry not found in the usual definition. To insure rapid and accurate computer implementation of common set-theoretic operations such as union, intersection, difference, etc., it is extremely useful to have a canonical well ordering on the set of computer-representable elements. By using an extremely large class of sets from ZF' (one which contains ZF) as the basic sets, such an ordering theory is developed. Computation of the ordering involves simple checks on trees in a top-down manner. Finally, in the framework developed, a new definition of Codd's first normal form is presented. In contrast to previous definitions, this one allows sets as well as urelements as domain elements, while being perfectly consistent with the axioms of ZF'.

40045 **Solution of non-linear differential equations by discrete least squares.** Eason, E.D. (Sandia Labs., Livermore, CA); Mote, C.D. Jr. *Int. J. Numer. Methods Eng.;* **12**: 597-612(1978).

A general-purpose technique was developed for solving nonlinear partial differential equations. A set of approximating functions with undetermined parameters is used to evaluate the differential equation and boundary conditions at discrete points, this operation forming a set of residuals to be minimized. The parameters which minimize the sum of squared residuals are determined by a nonlinear least-squares minimization technique. Initial-value problems are solved by integrating the equations with respect to time at the fitting points by a predictor—corrector algorithm. The resulting formulation is independent of the form of the problem and the approximating functions, so that a broad class of problems may be solved with a single computer program. The technique is applied to several boundary- and initial-value problems in one and two spatial dimensions. 5 figures, 5 tables.

40046 **Simulation test approach to the evaluation of nonlinear optimization algorithms.** Hillstrom, K.E. (Argonne National Lab., IL). *ACM Trans. Math. Software;* 3: No. 4, 305-315(Dec 1977).

A simulation test methodology was developed to evaluate unconstrained nonlinear optimization computer algorithms. The test technique simulates problems optimization algorithms encounter in practice by employing a repertoire of problems representing various topographies (descending curved valleys, saddle points, ridges, etc.), dimensions, degrees of nonlinearity (e.g., linear to exponential) and minima, addressing them from various randomly generated initial approximations to the solution and recording their performances in the form of statistical summaries. These summaries, consisting of categorized results and statistical averages, are generated for each algorithm as tested over members of the problem set. The individual tests are composed of a series of runs from random starts over a member of the problem set. Descriptions of the test technique, test problem, and test results are provided. 3 figures, 2 tables.

40047 **New algorithm for summing divergent series. Part 3. Applications.** Shenton, L.R. (Univ. of Georgia, Athens); Bowman, K.O. *J. Comput. Appl. Math.;* 3: No. 1, 35-51(1977).

Borel models are applied to summing series for the moments of the sample standard deviation, Student's t, and the skewness statistic $\sqrt{b_1}$. Sampling is from an exponential density. Comparisons are made with main diagonal Pade, Borel—Pade, and Monte Carlo simulations.

40048 **3rd annual symposium on computer architecture.** New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976). 207p. (CONF-760113—). IEEE Computer Society Publications Office, 5855 Naples Plaza, Suite 301, Long Beach, CA.

From 3. annual symposium on computer architecture; Clearwater, FL, USA (19 Jan 1976).

Thirty-three papers are included in these proceedings under the following headings: architecture evolution, hardware descriptive languages, education, multiprocessors, performance evaluation and modeling, applications, hardware/software system considerations, resource sharing and process coordination, networks, architectures to support software concepts, architectural features for performance enhancement, and secondary storage. One of these papers is abstracted and indexed separately; another has already been cited in ERA, and can be found by reference to the entry CONF-760113— in the Report Number Index. The remaining papers are not in scope for ERA. (RWR)

40049 (DOE/TIC—10097) **Discussion of session on reliability and warranty of numerical software.** Cowell, W.R. (Argonne National Lab., IL (USA)). [nd]. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

Legal aspects of computer programing as presented by several papers are discussed. Questions about protection of intellectual property, warranty of performance, and liability for misrepresentation of software increasingly being incorporated into proprietary libraries and disseminated through business enterprises are addressed. (RWR)

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 38859, 38910, 39029, 39583, 40041

40050 (CONF-790146—1) **Environmental data: management and needs analysis considerations.** Strand, R.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From 4. annual SAS User's group conference; Clearwater Beach, FL, USA (28 Jan 1979).

Environmental data are a resource of considerable value for evaluating trends and patterns in the environment in which we live. Consequently, it is important that these data be organized and accounted for in a systematic manner. This paper presents considerations involved in the management of environmental data for analysis and evaluation. The purposes of this paper are to: point out the variety of environmental data and how this variety puts emphasis on merging, sorting, and updating capabilities in a data management system; emphasize that a successful data management system requires a complete definition by the customer(s) of the problems requiring data management and the products that the data management system will yield or enhance; and encourage customers, implementors, and designers to document the problems to be addressed, capabilities to be developed, and products expected with a data management system.

40051 (ORNL—5508, pp 102-116) **Environmental Resources Section.** Burgess, R.L.; Adams, A.B.; Anderson, R.M. Apr 1979.

In Environmental Sciences Division annual progress report for period ending September 30, 1978.

Progress is reported on the following numerical data activities: numeric information handling; the geoecology project; the ecosystem analysis data center; the remote batch station; systems analysis and modeling; application of ecosystem models to energy technology assessment; and regional ecology-RARE II. Educational programs included ESD seminar program; graduate education program; and undergraduate education programs. (HLW)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Development of an Air Force Facilities Energy Information System. Master's thesis, 4:38991 (AD-A—059309)

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Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T—78-08)

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Information base for waste repository design. Volume 2. Equipment performance requirements, 4:38265 (NUREG/CR—0495(Vol.2))
Information base for waste repository design. Volume 3. Waste/rock interactions, 4:38266 (NUREG/CR—0495(Vol.3))
Information base for waste repository design. Volume .4 Mine structural features, 4:38267 (NUREG/CR—0495(Vol.4))
Information base for waste repository design. Volume 5. Decommissioning of underground facilities, 4:38268 (NUREG/CR—0495(Vol.5))
Information base for waste repository design. Volume 6. Excavation technology, 4:38269 (NUREG/CR—0495(Vol.6))
Information base for waste repository design. Volume 7. Executive summary, 4:38270 (NUREG/CR—0495(Vol.7))
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Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans—11473)
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans—11471)
AN SSSR, Moscow. Inst. Vysokikh Temperatur
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142—1)
Argonne National Lab., IL (USA)
Analysis of nonlinear fluid structure interaction transient in fast reactors, 4:38790 (ANL—78-103)
Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater, 4:38161 (ANL/WR—79-3)
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID—29425(Vol.2))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID—29425(Vol.1))
COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis, 4:38685 (NUREG/CR—0785)
Cost-allocation model for assessing the impact of energy-storage technologies upon electric utilities, 4:38897 (CONF-781213—6)
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants, 4:39539 (ANL/RER—78-2)
Discussion of session on reliability and warranty of numerical software, 4:40049 (DOE/TIC—10097)
Dry deposition and emission of small particles at the surface of the earth, 4:39529 (CONF-790101—6)
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region, 4:39909 (ANL/NDM—46)
Implementation and testing of optimization software, 4:40034 (DOE/TIC—10096)
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341—2)
Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM—40)
Mixed oxide run-beyond-cladding-breach tests in EBR-II, 4:38670 (HEDL-SA—1536-FP)
Modulated ordering Nb-H alloys, 4:39175 (CONF-790341—4)
Observation of superstructure in α—U near 43 K, 4:39102 (CONF-790341—1(Draft))
Observation of voltage fluctuations in a superconducting magnet during MHD power generation, 4:38958 (CONF-780952—24)
Qualification of stainless steel for OTEC heat exchanger tubes, 4:38410 (ANL/OTEC—001)
Quasinuclear colored quark model for hadrons, 4:39861 (FERMILAB-Conf—78/73-THY)
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Residential electric heating and cooling: total cost of service, 4:39003 (CONF-7809138—1)
Results of UO_2 diagnostic tests for run beyond cladding breach in EBR-II, 4:38661 (ANL—78-99)
Review on fluid forces on circular cylinders in cross flow, 4:38662 (ANL-CT—79-16)
Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system, 4:38684 (NUREG/CR—0001)
Septum magnet coil design principles, 4:39445 (DOE/TIC—10045)
Square function analysis of the Inductor-Converter Bridge, 4:39268 (ANL/FPP/TM—118)
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341—3)
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Spatial power control in large CANDU reactors: the whys and wherefores, 4:38751 (AECL—6212)
Validation of the KENO and SU-HAMMER codes for critical solution systems of U-233 and U-235, 4:39276 (AECL—5917)
Vibration of heat exchange components in liquid and two-phase cross-flow, 4:38731 (AECL—6184)
Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment
Criticality data for $(Pu,U)O_2$ fuel, 4:39275 (AECL—5807(rev.1))
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Annual technical progress report: reactor safety, Government fiscal year 1978, 4:38798 (ESG-DOE—13254)
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Atomics International Div., Golden, CO (USA). Rocky Flats Plant
Americium recovery and purification at Rocky Flats, 4:38241 (RFP—2886)
Pyrochemical coprocessing of UO_2—PuO_2 LMFBR fuel by the Salt Transport Method, 4:38242 (RFP—2887)
Recovery of plutonium from insulation, scrap glass, and sand-slag residues, 4:38257 (RFP—2835)
Rocky Flats experience with SDM/70, 4:40041 (RFP—2902)
Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations
Basalt waste isolation program. Quarterly report, October 1—December 31, 1978, 4:38272 (RHO-BWI—79-100-1Q)

Diets of mule deer within steppe vegetation of south central Washington, 4:39606 (BNWL-SA—6532)
Spent unreprocessed fuel (SURF) facility evaluation plan of the alternative storage concepts, 4:38247 (RHO-CD—271)
Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.
Who's Who III in the Interagency Energy/Environment R and D Program, 4:38892 (PB—284228)
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB—284375)
Automotive Testing Labs., Inc., Aurora, CO (USA)
Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in Chicago, Illinois. Final report, 4:39027 (PB—284941)
Avco-Everett Research Lab., Everett, MA (USA)
Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB—284092)

B

Barry (Theodore) and Associates, Los Angeles, CA (USA)
SAMICS marketing and distribution model, 4:38385 (N—78-30658)
Battelle Columbus Labs., OH (USA)
Fission product transport analysis. Quarterly progress report, January 1—March 31, 1978, 4:38816 (NUREG/CR—0697)
Fission product transport analysis. Quarterly progress report, April 1—June 30, 1978, 4:38817 (NUREG/CR—0698)
Fusion power development issues. Final report, 4:38942 (PB—285566)
Status report on ECC penetration scaling research, 4:38815 (NUREG/CR—0651)
Battelle Human Affairs Research Center, Seattle, WA (USA)
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL—2457)
Battelle Memorial Inst., Geneva (Switzerland)
Miniature TEA laser emitting picosecond pulses laser tea miniature emettant des pulses picosecondes, 4:39292 (N—78-28450)
Battelle Pacific Northwest Labs., Richland, WA (USA)
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL—2410-1(Rev.))
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL—2805)
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID—29425(Vol.1))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID—29425(Vol.2))
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL—2740)
Conceptual design of a nuclear waste vitrification facility, 4:38255 (PNL—2690)
Diets of mule deer within steppe vegetation of south central Washington, 4:39606 (BNWL-SA—6532)
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL—2738)
Heliostat reflective surface substrate characterization, 4:38408 (PNL—2810)
Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis, 4:38750 (NUREG/CR—0220)
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977—June 1978, 4:39572 (PNL—2829)
Physical modeling of joule heated ceramic glass melters for high level waste immobilization, 4:38256 (PNL—2809)
Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL—1948)
Bechtel National, Inc., San Francisco, CA (USA)
Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1, 4:38566 (AD-A—057405)
Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant, 4:38717 (ORNL/TM—6821)
Bendix Corp., Baltimore, MD (USA). Environmental and Process Instruments Div.
Development of an improved methane sampling system. Open file report, 4:38132 (PB—286006)
Bendix Corp., Englewood, CO (USA). Energy, Environment, and Technology Office
Roof bolting hazard analysis study. Final report, 1 July 1976—30 June 1977, 4:38099 (PB—284016)
Bendix Corp., Kansas City, MO (USA)
Deposition of aluminum—copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX—613-2173)
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND—78-1198)
Pulse plating of hard gold electrodeposits, 4:39101 (BDX—613-2165)
Bituminous Coal Research, Inc., Monroeville, PA (USA)
Gas Generator Research and Development: BI-GAS process. Quarterly report, July—September 1978, 4:38050 (FE—1207-53)
Gas generator research and development: BI-GAS Process. Interim report, July 1977—June 30, 1978, 4:38049 (FE—1207-49)
Black and Veatch, Kansas City, MO (USA)
Proposed issuance of a new source national pollutant discharge elimination system permit and section 10 and section 404 permits to Iowa Southern Utilities Company, Ottumwa generating station. Final environmental impact statement, 4:38600 (PB—285098)
Block Engineering, Inc., Cambridge, MA (USA)
RDA ruby laser frequency doubler system. Quarterly progress report no. 3, 24 oct 73-23 jan 74, 4:39281 (AD—923260)
Bodenheimer (B.A.) and Co., Inc., Stamford, CT (USA)
Air leakage in refrigerated vans. Final report, 4:39020 (COO—4338-4)
Boeing Aerospace Co., Seattle, WA (USA)
Simulation of space radiation effects on polyimide film materials for high temperature applications. Final report, 4:39197 (N—78-28604)
Boeing Computer Services Co., Falls Church, VA (USA)
Integrated safeguards information system (ISIS). Executive summary. Technical report, 4:38293 (PB—286869)
Bonneville Power Administration, Portland, OR (USA)
Response of a latticed transmission tower to wind. Final report, 4:38612 (PB—285123)
Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering
Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 6, 1 July 1978—30 September 1978, 4:38067 (TID—28953)
Briscoe, Maphis, Murray and Lamont, Inc., Boulder, CO (USA)
Action handbook for small communities facing rapid growth 'case study' Scobey, Montana. Final report, 4:38869 (PB—285870)
Brookhaven National Lab., Upton, NY (USA)
1.5 GeV/c multiturn shaving extraction and its transport line for the Brookhaven AGS, 4:39429 (BNL—25784)
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID—29425(Vol.2))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID—29425(Vol.1))
Atmospheric turbulence and diffusion boundary layer transport model, 4:39528 (BNL—25026)
Beam transfer from the AGS to ISABELLE, 4:39469 (BNL—25783)
Bunched beam neutralization, 4:39380 (BNL—25788)
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL—25730)
Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries, 4:38791 (BNL-NUREG—25714)
Comparison of particulate and gaseous material within and above the mixed layer, 4:39540 (BNL—25002)
Correction of the closed orbit and vertical dispersion and the tuning and field correction system in ISABELLE, 4:39467 (BNL—25755)

Design, construction, and operation update of the ISABELLE ring magnets, 4:39473 (BNL—25822)
Design status of the 2.5 GeV National Synchrotron Light Source x-ray ring, 4:39468 (BNL—25774)
Enhanced resistive wall instability for off-centered beams, 4:39470 (BNL—25793)
Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976—September 30, 1977, 4:39269 (BNL—50961)
Factors determining the choice of the beam tube material and the vacuum chamber design for a superconducting high energy storage accelerator, 4:39437 (BNL—25797)
Free electron laser and its possible developments, 4:39474 (BNL—25857)
Fusion reactors for synthetic fuels, 4:38301 (BNL—25634)
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL—25114)
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{2}H, 4:39692 (BNL—25910)
High field superconducting beam transport in a BNL primary proton beam, 4:39436 (BNL—25796)
ISABELLE magnet support and adjustment system, 4:39472 (BNL—25799)
(K,π) reaction at Brookhaven, 4:39822 (BNL—25879)
Laser-particulate control for open-cycle, coal fired gas turbines, 4:38601 (BNL—25587)
MPS configuration and performance characteristics, 4:39433 (BNL—25311)
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL—25733)
Neutrino—deuterium reactions in the 7-foot bubble chamber, 4:39819 (BNL—24848)
One- and two-dimensional heating analyses of fusion synfuel blankets, 4:40005 (BNL-NUREG—25635)
Possibility of acceleration of polarized protons in the Brookhaven AGS, 4:39434 (BNL—25734)
Reactor safety research programs. Quarterly progress report, July 1—September 30, 1978, 4:38812 (NUREG/CR—0513)
Status of ISABELLE lattice, 4:39471 (BNL—25798)
Systems framework for energy analysis in developing countries, 4:38860 (BNL—25933)
Tests of a new secondary emission chamber at the AGS, 4:39435 (BNL—25795)
Thermal hydraulics of accelerator breeder systems for regeneration of reactor fuel assemblies, 4:39438 (BNL—25880)
Unique parity states in ^{109}Pd from the (n,γ) reaction: calculations for rotation aligned and odd mass IBA models, 4:39908 (BNL—25877)

Brown Univ., Providence, RI (USA)
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO—4051-38)
Geothermal power plants of Italy: A technical survey of existing installations, 4:38538 (COO—4051-34)
Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations, 4:38534 (COO—4051-41)
Kakkonda Geothermal Power Plant, 4:38533 (COO—4051-40)

Brown Univ., Providence, RI (USA). Dept. of Engineering
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO—4051-27)

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Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977—October 31, 1978, 4:39931 (COO—3235-85)

Brown Univ., Providence, RI (USA). Div. of Engineering
Available work in geothermal energy, 4:38531 (COO—4051-25)
Thermodynamic and transport properties of isobutane: a survey of available data, 4:38541 (COO—4051-35)

Bundesministerium der Verteidigung, Bonn (Germany, F.R.). Abt. Wehrtechnik
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT—78-20)

Burbank City Council, CA (USA)
Science advisor report to Burbank City Council, 1975—1976, 4:39051 (PB—283860)

Bureau of Radiological Health, Rockville, MD (USA)
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB—285628)
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Measurements of electromagnetic fields in the close proximity of CB antennas, 4:39701 (FDA—79-8080)

Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center
Historical, physical, and chemical limnology of Twin Lakes, Colorado, 4:39632 (PB—283848)

C

California Assembly Permanent Subcommittee on Energy, Sacramento (USA)
Natural gas shortage. Final report, 4:38178 (PB—283875)
Report to the legislature on the constitutionality of California's nuclear laws, 4:38895 (PB—285131)

California Dept. of Water Resources, Sacramento (USA)
Final environmental impact report on the long range energy program for the California State Water Project. Final report, 4:38876 (PB—283822)
Water for power plant cooling, 4:38574 (PB—285126)

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Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping, 4:38826 (UCB/EERC—79/08)

California Univ., Berkeley (USA). Dept. of Physics
The potential for astrometry in the infrared, 4:39734 (N—78-31017)

California Univ., Berkeley (USA). Lawrence Berkeley Lab.
Application of x-ray emission spectra to the identification of particulate sulfur compounds in ambient air, 4:39544 (LBL—7284)
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID—29425(Vol.2))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID—29425(Vol.1))
Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL—7999)
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL—8893)
Changes in the electrocardiograms of rats and dogs exposed to dc magnetic fields, 4:39702 (LBL—9085)
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu, 4:39795 (LBL—8932)
Chemical reduction of refractory oxides by atomic hydrogen, 4:39254 (LBL—8548)
Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL—8814)
Computed tomographic reconstruction of beam profiles with a multi-wire chamber, 4:39459 (LBL—8947)
Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies, 4:38512 (LBL—8802)
Doublet III neutral beam source cryopanel system, 4:40019 (LBL—8900)
Dynamical birth and thermal death of angular momentum in heavy ion reactions, 4:39914 (LBL—8613)
Evaluation of Coso Geothermal Exploratory Hole No. 1 (CGEH-1) Coso Hot Springs: KGRA, China Lake, CA, 4:38526 (LBL—8675)
Heterogeneous catalysis research meeting, 4:39238 (LBL—8975)
Indoor air quality in energy-efficient buildings, 4:38995 (LBL—8892)
Large fragment production calculations in relativistic heavy-ion reactions, 4:39865 (LBL—8561)
Molecular beam studies of unimolecular reactions: Cl, F + C_2H_5Br, 4:39794 (LBL—7686)
Multipion production in nuclear collisions, 4:39934 (LBL—8758)
Noise considerations in millimeter-wave spectrometers, 4:39494 (LBL—7294)
PEP II RF system, 4:39479 (LBL—8887)
Precision magnetic measurements by the floating wire analog technique, 4:39458 (LBL—8818)

Proceedings of the workshop on producing high luminosity high energy proton-anti proton collisions, 4:39475 (LBL—7574)
Proposed orbit and vertical dispersion correction system for PEP, 4:39483 (SLAC-PUB—2265)
Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces, 4:39772 (LBL—7687)
Results of reservoir engineering tests, 1977, East Mesa, California, 4:38546 (LBL—7091)
Role of deep inelastic processes in nuclear physics: experimental and theoretical aspects of deep inelastic reactions, 4:39834 (LBL—8936)
Secondary emission monitors at the Bevatron-Bevalac, 4:39457 (LBL—8808)
Simulation of the Krafla Geothermal Field, 4:38518 (LBL—7076)
Small particle heat exchangers, 4:38407 (LBL—7841)
Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings, 4:38470 (LBL—7811)
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A, 4:39887 (LBL—8463)
Thermal properties of Gable Mountain basalt cores, Hanford Nuclear Reservation, 4:39725 (LBL—7038)
Vibrational energy transfer in selectively excited diatomic molecules, 4:39784 (LBL—8208)

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Appendices to "On the dependence of necking upon loading history", 4:39806 (UCID—18161)
Automating the Analytical Laboratories Section, Lewis Research Center, National Aeronautics and Space Administration: a feasibility study, 4:39204 (UCRL—52594)
Computer automation of continuous-flow analyzers for trace constituents in water. Volume 4. Description of program segments. Part 1. TAAIN, 4:39203 (UCRL—52532(Vol.4)(Pt.1))
Computer language evaluation for MFTF SCDS, 4:39974 (UCID—18089)
Convection and thermal radiation analytical models applicable to a nuclear waste repository room, 4:38274 (UCID—18103)
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL—81879)
Development of alternate silicone potting compounds. Vol.4. Development of a substitute for Dow Corning's aerospace sealant DC 93-120 resin cured with DC 93-122 curing agent, 4:39182 (UCRL—52434(Vol.4))
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Effects of torus wall flexibility on forces in the Mark I boiling water reactor pressure suppression system. Final report, 4:38821 (NUREG/CR—0746)
Electronics of the target diagnostics system for the Shiva Laser Fusion Facility, 4:40014 (UCRL—52521)
Energy and technology review, 4:39293 (UCRL—52000-79-3)
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Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL—82181)
H.E. EMP: The "HASH", 4:39520 (UCID—18165)
High temperature science: future needs and anticipated development in high-density shock-wave research, 4:39946 (UCID—18072)
Improved tandem mirror fusion reactor, 4:40002 (UCID—18156)
Introduction to self-induced rainout, 4:39582 (UCRL—52669)
Inversion of one-dimensional scattering data using Prony's method, 4:39962 (UCRL—52667)
Large-area boron and carbon scatterers and filters, 4:39187 (UCID—18077)
Laser-plasma coupling, 4:40015 (UCRL—81896)
Lawrence Livermore Laboratory heavy ion fusion program, 4:40016 (UCRL—82120)
Limitations to the use of two-dimensional thermal modeling of a nuclear waste repository, 4:38273 (UCID—18101)
LLL dynamic high pressure experiments, 4:39981 (UCRL—82272)
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LLL gas stimulation program. Quarterly progress report, October—December 1978, 4:38181 (UCRL—50036-78-4)
MAP3S programs applicable to PEPE's, 4:39573 (UCRL—82549)
Morey mill retrofit, 4:39262 (UCID—18170)
Multigamma-ray calibration sources, 4:39942 (M—100)
Nuclear chemistry counting facilities: requirements definition, 4:39210 (UCID—18151)
Positron lifetime study of copper irradiated by energetic protons or energetic neutrons, 4:39169 (UCRL—82159)
Precision machining vs. optical process, 4:39096 (UCRL—82528)
Progress in space charge lens development, 4:39423 (UCRL—81834)
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region, 4:39923 (UCRL—81909)
Review of tube support plate analysis for steam generators of Millstone Unit II Nuclear Power Plant, 4:38634 (UCID—17958)
Rupture-safe pressure transducers, 4:39509 (UCRL—82358)
Seismic monitoring: a unified system for research and verifications, 4:39714 (UCRL—52665)
Some results from continuum mechanics analyses of the hydraulic fracturing process, 4:38182 (UCRL—81707)
Stratospheric H_2O, 4:39533 (UCRL—82542)
Structural response of VRO and FKM propellants during a rocket motor implosion, 4:39261 (UCID—18160)
Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL—52640)
Waste-isolation projects, FY 1978, 4:38275 (UCRL—50050-78)
Wave resistance in a rotating liquid layer, 4:39327 (UCRL—82436)
X-ray microdensitometer (XRPD) performance characteristics, 4:39498 (UCRL—52657)
X-ray reflectivity vs mirror surface quality, 4:39960 (UCID—18030)

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Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE—2496-12)
Computer-aided analysis of coal gasification pilot plant data bases, 4:38060 (FE—2496-26)

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Application of the FLIRA code to fit ERSEC experiments, 4:38792 (CEA-CONF—3999)
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Study of the effect of hard projectiles impacting reinforced concrete walls, 4:38793 (CEA-CONF—4035)
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Neutronic control instrumentation of protection systems, 4:38733 (CEA-CONF—3997)
Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.
User's guide to the reactor inventory code RICE, 4:38725 (RD-B-N—4079)
Central Electricity Generating Board, London (UK)
A triggered co-ordinating gap for metalclad substations, 4:38611 (N—78-28360)
Measurement of pulverized fuel flow to burners using an acoustic technique, 4:38569 (N—78-28387)
Oxide thickness monitor, 4:39506 (N—78-28429)
Superconducting disc alternator, 4:39271 (N—78-28354)
Tipping-vessel recording raingauge, 4:39548 (N—78-28761)
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Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB—284013)
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Controlled fusion and plasma physics. Vol. II, 4:40003 (INIS-mf—4125)
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Chicago Univ., IL (USA)
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Cincinnati Univ., OH (USA). Dept. of Biological Sciences
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963—1975, 4:39607 (DOE/EV—2307-15)
Cincinnati Univ., OH (USA). Dept. of Economics
Planning water supply: cost-rate differentials and plumbing permits. Final report, 4:39052 (PB—285656)
Cities Service Co., Jackson, MS (USA)
Bodcau In Situ Combustion Project. Second annual report, July 1, 1977—June 30, 1978, 4:38144 (SAN—1189-3)
Clinch River Breeder Reactor Plant Project Office, Oak Ridge, TN (USA)
Welding for the CRBRP steam generators, 4:38667 (GEFR-SP—151)
Coast Guard Research and Development Center, Groton, CT (USA)
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR—3490-1480)
Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering
Clean solid and liquid fuels from coal. Quarterly progress report, April—June 1978, 4:38074 (FE—2047-9)
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Stratified thermal storage in residential solar energy applications, 4:38504 (COO—4523-1)
Columbia Univ., New York (USA)
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Columbia Univ., New York (USA). Dept. of Mathematical Statistics
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO—2874-46)
Columbia Univ., New York (USA). School of Public Health
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Physical management of coastal floodplains: guidelines for hazards and ecosystems management. Report on task 1, 4:39594 (PB—284164)
Cornell Univ., Ithaca, NY (USA)
Far infrared polarization of the Kleinmann—Low nebula in orion, 4:39733 (N—78-28025)
Cornell Univ., Ithaca, NY (USA). Center for Radiophysics and Space Research
Observations of the 51.8 micron (O III) emission line in Orion, 4:39732 (N—78-28024)
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Kaon interactions with very light nuclei, 4:39831 (LA-UR—79-653)
LAMPF primary beam line protection system, 4:39406 (LA-UR—79-750)
Linac particle tracing simulations, 4:39404 (LA-UR—79-709)
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Monitor 1979, 4:39451 (LA-UR—79-689)
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Pion single charge exchange, 4:39885 (LA-UR—79-638)
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Adsorption of neptunium and plutonium on metal phosphites, 4:38252 (MLM—2595)
Evaluation of a large nonconvective solar pond, 4:38492 (MLM—2606(OP))
Feasibility of a Mound-designed transportable calorimeter, 4:38292 (MLM—2603)
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N

Nagoya Univ. (Japan). Inst. of Plasma Physics
A new treatment of localized modes in inhomogeneous Vlasov plasma, 4:39996 (N—78-27915)
Plasma flow driven by fusion-generated alpha particles, 4:39965 (N—78-27917)
Radio-frequency plugging of a high density plasma, 4:39964 (N—78-27916)
National Aeronautics and Space Administration, Cambridge, MA (USA). Electronics Research Center
Low-frequency fluctuation spectra and associated particle transport in the NASA Lewis Bumpy-Torus plasma, 4:39997 (N—78-30944)
National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center
Comparison of three experimental methods used in determining the thermal performance of flat-plate solar collectors. Ph.d. thesis - Kansas Univ, 4:38493 (N—78-28614)
Cost of photovoltaic energy systems as determined by balance-of-system costs, 4:38380 (N—78-27539)
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N—78-28225)
Outline of cost-benefit analysis and a case study, 4:38390 (N—78-31954)
Performance of a thermionic converter module utilizing emitter and collector heat pipes, 4:38985 (N—78-27174)
Solubility, stability, and electrochemical studies of sulfur—sulfide solutions in organic solvents, 4:38849 (N—78-28624)
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A three-dimensional model of corotating streams in the solar wind. 1: theoretical foundations, 4:39744 (N—78-28031)
An emission mechanism for the Io-independent Jovian decameter radiation, 4:39758 (N—78-31027)
Diffuse fluxes of cosmic high energy neutrinos, 4:39730 (N—78-31040)
Direct measurements of the polarization of terrestrial kilometric radiation from Voyagers 1 and 2, 4:39757 (N—78-30758)
Discovery of iron line emission in the Hercules X-1 low-state spectrum with HEAO-1, 4:39740 (N—78-31038)

Discrepancy in proton flux extrapolation along field lines in the middle Jovian magnetosphere, 4:39759 (N—78-31028)
Greenbelt community project: solar energy retrofit for a multi-family dwelling, 4:38474 (N—78-31539)
High energy x-ray spectra of Cygnus XR-1 observed from OSO-8, 4:39742 (N—78-32017)
Life test results for an ensemble of CO^2 lasers, 4:39290 (N—78-27404)
Solar gamma rays above 8 MeV, 4:39751 (N—78-32031)
X-ray observations of a flare in NGC4151 from OSO-8, 4:39739 (N—78-31021)
X-ray observations of BL Lac objects, 4:39741 (N—78-32016)

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Corrosion inhibitors for solar heating and cooling systems, 4:38473 (N—78-30202)
Development, testing, and certification of Owens—Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM—78223)
Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report, 4:38489 (DOE/NASA/TM—78219)
Disposal of radioactive iodine in space, 4:38263 (N—78-31740)
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR—161190)
Solar tracking control system Sun Chaser, 4:38491 (DOE/NASA/TM—78225)
System design package for solar heating and cooling system installed at Akron, Ohio, 4:38464 (DOE/NASA/CR—161192)

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Pioneer 10 observation of the solar wind proton temperature heliocentric gradient, 4:39748 (N—78-31030)

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An evaluation of in situ ozone sensor performance during a cold frontal passage, 4:39532 (N—78-27706)

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Brief review of the Resource Conservation and Recovery Act (RCRA) 1976, 4:38875 (CONF-790331—1)
Calorimetric assay of HTGR fuel samples, 4:38226 (ORNL/TM—6665)
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM—6609)
Charge exchange measurements on ISX-A, 4:39979 (ORNL/TM—6823)
Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc, 4:39601 (CONF-781105—100)
Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415—25)
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM—6660)
Concept evaluation of a nuclear design for electronuclear fuel production: evaluation of ORNL's proposed TMF—ENFP, 4:39460 (ORNL/TM—6828)
Control system for the Holifield Heavy Ion Research Facility beam buncher, 4:39443 (CONF-790327—9)
Department of Energy fossil energy equipment development programs, 4:38048 (CONF-790405—14)
Development of in-vessel reflood instrumentation at ORNL, 4:38794 (CONF-790340—1)
Economics of gasoline production from underground coal gasification via Mobil-M process, 4:38047 (CONF-790405—12)
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Implementation of the ORIC magnetic field measurements, 4:39442 (CONF-790327—8)
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Mass transfer in two-phase nondispersing liquid—liquid contactors with a high-density-difference system, 4:39215 (ORNL/TM—6670)
Measurement error in pressure-decay leak testing, 4:39259 (ORNL/TM—6855)
Negative ions of polyatomic molecules, 4:39783 (CONF-790344—1)
New materials properties achievable by ion implantation doping and laser processing, 4:39196 (CONF-781121—22)
Nuclear performance of molten salt fusion—fission symbiotic systems for catalyzed DD and DT reactors, 4:40010 (ORNL/TM—6560)
Nuclear performance of target-blanket assemblies for electronuclear fuel production, 4:39360 (CONF-780622—30)
Observation of superstructure in α—U near 43 K, 4:39102 (CONF-790341—1(Draft))
Overview of waste heat utilization techniques, 4:39039 (CONF-790443—2)
Photochemistry of the actinides, 4:39253 (CONF-790415—21)
Practical aspects of glass capillary gas chromatography, 4:39214 (CONF-790330—1)
Processes for immobilization of high-level solid wastes by glass and ceramic matrices, 4:38250 (CONF-790420—9)
Proposed industrial energy data base for technical evaluation of alternative energy systems, 4:39028 (CONF-781244—1)
Radioactive waste fixation in FUETAP (formed under elevated temperature and pressure) concretes-experimental program and initial results, 4:38254 (ORNL/TM—6573)
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM—6672)
Role of mathematical modeling in low-level radioactive waste management, 4:38260 (CONF-790331—2)
Selected advances in materials research, 4:39106 (CONF-790343—1)
SEM observations and EDX analyses of secondary mineralization in a bituminous coal, 4:38082 (CONF-790418—4)
Single-crate stand-alone CAMAC control system for a negative ion source test facility, 4:39426 (CONF-790327—10)
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Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL—5486)
Solid waste handling and decontamination facility, 4:38249 (CONF-790331—4)
Static correlations in semidilute polymer solutions, 4:39181 (CONF-790415—24)
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons, 4:39900 (ORNL/TM—6637)
Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems, 4:38642 (ORNL/TM—6478)
Structure solution methods for superstructures, 4:39945 (CONF-790342—1)
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415—31)
Theory of electron transfer and ionization, 4:39789 (CONF-790438—1)
Oak Ridge Y-12 Plant, TN (USA)
Biological denitrification of industrial strength nitrate wastes, 4:39049 (Y/DA—8220)
Computer automation of an electron-beam welder, 4:39097 (Y/DA—8239)
Interfacing the linear motor slide drive to a precision machine tool, 4:39263 (Y—2180)
Microcomputer-based video motion detection system, 4:38299 (Y/DA—7999)
Microinterferometer transducer, 4:39510 (Y/DA—7109)
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Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna
Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE—2875)
Principles of measurement and of safety surveillance for the PCPV/helium-loop, 4:38743 (SGAE—2820)

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Analytical modeling techniques of a lattice-type tower. Master's thesis, 4:38613 (PB—285190)
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Does DNA have two structures in solution that coexist at equilibrium, 4:39637 (UR—3490-1569)
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR—3490-1480)
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Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR—3490-1574)
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Anisotropic constitutive equation for use in finite difference wave propagation calculations, 4:39810 (SAND—79-0382)
Application of ion channeling to radiation damage studies, 4:39168 (SAND—79-0497C)
Boron nitride ablation studies in arc jet facilities, 4:39179 (SAND—79-0413C)
Commercially available video motion detectors, 4:38295 (SAND—79-0186)
Comparison of some characteristics of finite element and finite difference calculations of transient thermal problems, 4:39326 (SAND—78-8047)
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND—78-0681)
Controllability/observability analysis of digital circuits, 4:39339 (SAND—78-1859C)
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND—79-0246C)
DEEP STEAM Project 16 enhanced oil recovery. Quarterly report, October 1—December 31, 1978, 4:38145 (SAND—79-0562)
Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND—78-0982)
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Development of a unique pyrotechnic actuator, 4:39518 (SAND—78-1731C)
Dielectric stimulated arcs in lightning arrestor connectors, 4:38614 (SAND—79-0396C)
Enhanced gas recovery program. Third annual report, October 1977—September 1978, 4:38180 (SAND—79-0056)
Environmental impact of accidents involving radioactive material shipping systems, 4:39279 (SAND—78-1584C)
Extension of high temperature electronics, 4:39340 (SAND—79-0388C)
Heat loss reduction techniques for annular solar receiver designs, 4:38499 (SAND—78-1769)
Helios model for the optical behavior of reflecting solar concentrators, 4:38496 (SAND—76-0347)
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Interim summary of Sandia creep experiments on rock salt from the WIPP study area, southeastern New Mexico, 4:39727 (SAND—79-0115)
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Observations of the vacuum arc and metal transfer during vacuum consumable arc remelting, 4:39095 (SAND—79-0922C)
Operation of repetitively pulsed 300 kV, 20 kA electron beam diode, 4:39461 (SAND—79-0596C)
Performance testing of the del concentrating solar collector, 4:38501 (SAND—79-0515)
Proposed standard for ES and H assurance programs, 4:39704 (SAND—79-0240)
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Role of surface contaminants in the deformation welding of gold to thick and thin films, 4:39093 (SAND—79-0352C)
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Security seal handbook, 4:38294 (SAND—78-0400)
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Technology development for high temperature logging tools, 4:38527 (SAND—79-0013C)
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Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL—8814)
Generator gas: the Swedish experience from 1939—1945, 4:39090 (SERI/SP—33-140)
Implementation of state solar incentives: financial programs, 4:38361 (SERI/TR—51-160)
Implementation of state solar incentives: research, development, and demonstration programs, 4:38353 (SERI/TR—51-161)
Implementation of state solar incentives: state testing and certification, 4:38362 (SERI/TR—51-162)
Organized labor and solar energy, 4:38368 (SERI/TR—62-148)
Photobiological production of hydrogen: a solar energy conversion option, 4:38309 (SERI/TR—33-122)
Proceedings of the desiccant cooling conference of November 16, 1977, 4:38481 (SERI—22)

SERI: the first year, 4:38352 (SERI/SP—11-142)
Solar energy commercialization and the labor market, 4:38367 (SERI/TP—53-123)
Status of information for consumers of small wind energy systems, 4:38563 (SERI/TP—51-158)
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Nuclear facility monitoring in South Carolina, 4:39604 (PB—283837)
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Geothermal power plants of Italy: A technical survey of existing installations, 4:38538 (COO—4051-34)
Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations, 4:38534 (COO—4051-41)
Kakkonda Geothermal Power Plant, 4:38533 (COO—4051-40)
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Longitudinal feedback system for PEP, 4:39484 (SLAC-PUB—2267)
Modeling a horizontal wiggler in an electron storage ring, 4:39480 (SLAC-PUB—2255)
Parity violation in inelastic scattering of polarized electrons, 4:39815 (SLAC-PUB—2218)
Properties of a linac-storage ring stretcher system, 4:39482 (SLAC-PUB—2262)
Proposed orbit and vertical dispersion correction system for PEP, 4:39483 (SLAC-PUB—2265)
Quantum chromodynamics and the dynamics of hadrons, 4:39856 (SLAC-PUB—2298)
Trip report: UCSB earthquake damage survey, 4:39711 (SLAC-TN—79-1)
Trirotron, 4:39462 (SLAC-PUB—2266)
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A study of large-scale solar magnetic and velocity fields, 4:39745 (N—78-29027)
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An energy analysis of Tasmanian barley, hops and beer production, 4:39033 (PB—283950)
Energy analysis: a Tasmanian application, 4:38862 (PB—283949)
Energy analysis of zinc production, 4:39034 (PB—283951)
The energy cost of road and rail transport in Tasmania, 4:39025 (PB—283952)
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Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations, 4:38758 (DOE/ET—0064/2)
Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development
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U.S. Navy energy plan and program, 1978. Technical report, 4:38914 (AD-A—058054)
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The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB—283975)
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Shallow land burial - why or why not, 4:38261 (CONF-790331—3)
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U

UKAEA, Harwell. Atomic Energy Research Establishment
Heat transfer aspects of underground disposal of radioactive waste, 4:38259 (AERE-R—8790)
Unified Industries, Inc., Alexandria, VA (USA)
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC—10064)
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC—10066)
United Nuclear Industries, Inc., Richland, WA (USA)
Radiation exposure usage accountability and impact with respect to ALAP (ALARA) analysis, 4:38785 (UNI—1197)
University of Southern Mississippi, Hattiesburg (USA). Dept. of Polymer Science
Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977—September 1978, 4:39235 (BETC—5603-5)
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978—December 31, 1979, 4:39236 (BETC—5603-6)
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High-temperature reactor, 4:38715 (INIS-mf—4494)
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V

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Vermont energy conservation plan, 4:38903 (PB—285508)
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W

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The nation's water resources: the Second National Water Assessment. Part III. Functional water uses, 4:38883 (PB—285749)
The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations, 4:38884 (PB—285750)
The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries, 4:38885 (PB—285751)
The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data, 4:38886 (PB—285815)
The nation's water resources: the Second National Water Assessment. Part I. Introduction, 4:38881 (PB—285747)
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Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for period ending September 30, 1978, 4:38238 (WCAP—9422)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.
Application of advanced accountability concepts in mixed oxide fabrication, 4:38228 (WCAP—9104)
Impact of receipt of coprocessed uranium/plutonium on advanced accountability concepts and fabrication facilities. Addendum 1 to application of advanced accountability concepts in mixed oxide fabrication, 4:38229 (WCAP—9104(Add.1))
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP—9104(Add.2))
Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP—9104(Add.3))
Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application, 4:38297 (WCAP—9344)
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for the period ending December 31, 1977, 4:38237 (WCAP—9293)
Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation, 4:38298 (WCAP—9345)
State of the art survey and measurements of releases within confinement structures from MOX fuel fabrication components, 4:38236 (WCAP—9282)
State-of-the-art survey of residual holdup in a 200 mt/yr MOX fuel fabrication facility, 4:38296 (WCAP—9128)
Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility, 4:38235 (WCAP—9278)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313—4)
Westinghouse Hanford Co., Richland, WA (USA)
BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME—78-103)
Mixed oxide run-beyond-cladding-breach tests in EBR-II, 4:38670 (HEDL-SA—1536-FP)
Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)
Review of waste management for a large-scale mixed oxide fuel fabrication facility, 4:38232 (WCAP—9144)
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313—4)
State-of-the-art survey of pneumatic powder transport, 4:38233 (WCAP—9189)
Waste management state-of-the-art review for mixed-oxide fuel fabrication facilities, 4:38234 (WCAP—9200)
West Virginia Geological and Economic Survey, Morgantown (USA)
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR—79/5)
West Virginia Univ., Morgantown (USA)
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR—79/5)
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West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography
Analysis of the structural parameters that influence gas production from the Devonian shale. Volume 1. Executive Summary and Task Reports. Annual progress report, 4:38177 (ORO—5194-2(Vol.1))
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Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978—December 31, 1978, 4:38619 (COO—5014-3)
Fast magnetosonic wave heating of the NUWMAK tokamak reactor, 4:39966 (UWFDM—227)
Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering
Tokamak reactors and structural materials, 4:40007 (UWFDM—288)
Wisconsin Univ., Madison (USA). Dept. of Physics
Some remarks on grand unified models, 4:39835 (UH—511-330-79)
Wyle Labs., Huntsville, AL (USA). Solar Energy Systems Div.
Long term weathering effects on the thermal performance of the Solaron (air) solar collector, 4:38488 (DOE/NASA/CR—161166)
Wyoming Univ., Laramie (USA)
Pion-nucleon interaction and mesonic atoms. Progress report, 1 February 1978—31 January 1979, 4:39829 (COO—2197-63)
University of Wyoming Energy Symposium, 4:38904 (PB—285510)

Y

Young (Arthur) and Co., Washington, DC (USA)
Short term coal demand model. Final report, 4:38127 (DOE/TIC—10089)
Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)
Contribution from U.S. system suppliers to the power generating industry, 4:38732 (AED-Conf—78-048-003)
Design and testing of power plant controls by means of simulation, 4:38568 (AED-Conf—78-155-024)

Increased productivity in power plants by the computer-based information system PRAUT, 4:38567 (AED-Conf—78-155-017)
New and already approved - the power plant control system PROCONTROL K by Brown-Boveri, 4:38752 (AED-Conf—78-155-027)
Physical fundamentals of reactor engineering, 4:38720 (AED-Conf—78-023-002)
Safety analyses for high-temperature reactors, 4:38789 (AED-Conf—78-023-004)
Transmission and distribution of information in power plants, 4:38753 (AED-Conf—78-155-033)
U-type steam generators for nuclear power plants and their manufacture, 4:38630 (AED-Conf—78-155-006)

AUTHOR INDEX

Authors "surnames are indexed in the form appearing in the abstracted publication; given names are reduced to initials. Each author entry gives the publication title and the citation number. Report numbers, if applicable, are given in parentheses at the end of the entry. For publications with multiple authors, an author entry is provided for each. Entries for the second and succeeding authors give references to the first author.

Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

A

Abe, M., *See* Shida, I., 4:38522
Abraham, G., Entrainment solutions for jet discharge into deep water, 4:39624
Abrams, G.S., *See* Gelfand, N., 4:39862
See Heile, F.B., 4:39846
Abramyan, E.A., Energy recovery and power stabilization of pulsed electron beams in Marx generator circuits, 4:39393 (CONF-771035—P2, pp 755-760)
Microsecond intensive e-beams, 4:39392 (CONF-771035—P2, pp 743-754)
Abuaf, N., *See* Greene, G.A., 4:38791
Ackerman, E., *See* Beazley, R., 4:38093
Ackermann, G.R., *See* Start, G.E., 4:38763
Adachi, R.S., *See* Jaklevic, J.M., 4:39545
Adachi, S., *See* Baba, K., 4:38536
Adams, A.B., *See* Burgess, R.L., 4:40051
Adams, S.M., *See* Brocksen, R.W., 4:39620
See Coutant, C.C., 4:39621
Adams, T.F., *See* Davis, C.G., 4:39731
Adamski, J.L., Collective ion acceleration in a vacuum diode, 4:39381 (CONF-771035—P2, pp 497-507)
Adkins, J.H., Roof bolting hazard analysis study. Final report, 1 July 1976—30 June 1977, 4:38099 (PB—284016)
Adler, R., Wave accelerator for collective ion acceleration, 4:39382 (CONF-771035—P2, pp 509-520)
Aggus, J., Factors determining the choice of the beam tube material and the vacuum chamber design for a superconducting high energy storage accelerator, 4:39437 (BNL—25797)
Agha, M.F., Quantitative method for the design of buildings with comfortable microclimates by passive control of solar effects, 4:38453 (CONF-780337—P3, pp 6p, Book 1, Paper 4)
Agnew, L., Graphite targets for use in high intensity beams at LAMPF, 4:39450 (LA-UR—79-688)
Agrawal, A.K., Reactor safety research programs. Quarterly progress report, July 1—September 30, 1978, 4:38812 (NUREG/CR—0513)
Ahlen, S.P., Optical Cerenkov radiation from microscopic $BaSO_4$ grains, 4:39504
Ahmad, I., Electric monopole transitions and excited 0^+ states in ^{250}Cf, 4:39920
Ahrens, T.J., *See* Ross, M., 4:39946
Akhmetshina, I.Z., Effect of active water-soluble organic compounds of petroleum on salt deposits in petroleum equipment, 4:38157
Aki, K., Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1977—August 31, 1978, 4:38520 (COO—2534-4)
Alam, M.S., *See* Heile, F.B., 4:39846
Albers, D.F., *See* Siems, P.L., 4:38206
Albrecht, L., Aims of a measurement program to detect unplanned radioactive discharges from nuclear power stations equipped with light-water reactors, and requirements for the measuring instruments, 4:38828
Albrecht, R.W., *See* Carey, W.M., 4:38698
Alcouffe, R.E., *See* Dudziak, D.J., 4:38724
Aldrich, D., *See* Bayer, A., 4:38824
Alexander, J.K., *See* Kaiser, M.L., 4:39757
Alexander, S.S., Relationship between near-field and teleseismic observations of seismic source parameters. Final report 1 Apr 73-30 Sep 77, 4:39526 (AD-A—059529)
Ali, A.W., Proton beam excited lasers, 4:39286 (CONF-771035—P2, pp 871-878)
Allen, C., *See* Clark, G., 4:38357
Allen, C.P., *See* Gehrs, C.W., 4:38090
See Tamura, T., 4:38087
Allen, E.J., Calorimetric assay of HTGR fuel samples, 4:38226 (ORNL/TM—6665)
Allen, M.A., Longitudinal feedback system for PEP, 4:39484 (SLAC-PUB—2267)
Allen, R.J., *See* Mills, F.S., 4:39546
Allen, T., *See* Van Hook, R.I., 4:39615
Aller, D.J., *See* Carr, P., 4:38844
Allinger, J., High field superconducting beam transport in a BNL primary proton beam, 4:39436 (BNL—25796)
Allison, K.L., *See* Jones, G.T., 4:38374
Allison, L.J., *See* Van Hook, R.I., 4:39615
Allison, P.W., *See* Sherman, J.D., 4:39405
Allsup, J.R., Ethanol/gasoline blends as automotive fuel, 4:39089 (BETC/RI—79/2)
Almassy, M.Y., *See* Washburn, D.F., 4:38670
See Weber, J.W., 4:38669
Almgren, D.W., Evaluation of solar cells and arrays for potential solar power satellite applications. Final report, 4:38402 (N—78-27538)
Alonso, J., Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu, 4:39795 (LBL—8932)
Alonso, J.R., Computed tomographic reconstruction of beam profiles with a multi-wire chamber, 4:39459 (LBL—8947)
Alsmiller, R.G. Jr., Nuclear performance of target-blanket assemblies for electronuclear fuel production, 4:39360 (CONF-780622—30)
Altercop, B.A., *See* Abramyan, E.A., 4:39392
Alton, G.D., *See* Knudsen, H., 4:39940
Altstetter, C.J., *See* Tortorelli, P.F., 4:39777
Alvares, N.J., *See* Parks, D.J., 4:39255
Alverson, G.O., *See* Kirk, T.B.W., 4:39825
Amann, J.F., *See* Dytman, S.A., 4:39896
Amat, M.T., *See* Paillous, A., 4:39184
Amick, C.H., *See* Martinez-Baez, L.F., 4:39725
Amols, H., *See* Paciotti, M., 4:39453
Anantatmula, R.P., Control of beryllium-7 in liquid lithium, 4:40013 (HEDL-SA—1594-FP)
Anders, W.L., *See* Bucy, J.I., 4:39045
Anderson, B., Barriers, advantages, and incentives for passive solar design, 4:38420 (CONF-780337—P1, pp 5p, Book 1, Paper 4)
Anderson, B.D., Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
Anderson, D.G., Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report, 4:39724 (EPRI-NP—920)
See Hanson, M.E., 4:38181
Anderson, D.J., *See* Coutant, C.C., 4:39621
Anderson, G.L., *See* Tran, D.Q., 4:38063
Anderson, H.L., *See* Bowman, J.D., 4:39818
Anderson, J.A., *See* White, W.H., 4:39575
Anderson, O.L., Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA—6915-MS)
Water pollution control for coal slurry pipelines. Final report, 4:38121 (SAI—068-79-516)
Anderson, R.E., Computer language evaluation for MFTF SCDS, 4:39974 (UCID—18089)
Anderson, R.M., *See* Burgess, R.L., 4:40051
See Gehrs, C.W., 4:38090
Anderson, T.T., *See* Carey, W.M., 4:38698
Anderson, V.E., *See* Ashley, J.C., 4:39939

Anderson, W.A., Silicon schottky photovoltaic diodes for solar energy conversion. Final report, 1 June 1975—31 May 1978, 4:38391 (PB—283998)
Anderson, W.W., *See* Jonath, A.D., 4:39188
Andreev, A.M., Electromagnetic pumps for fast reactors primary cooling circuits, 4:38683 (NIIEFA-A—0340)
Andreev, A.P., Role of gravitational field transformations in studying deep, density separation boundaries in the precaspian depression, 4:39721
Andrews, L.A., *See* Brainard, J.P., 4:38614
Andriyanov, V.N., *See* Intyashin, A.D., 4:38147
Angelis, A.L.S., Measurement of inclusive π^0 production at large p/sub T/ from p-p collisions at the CERN ISR, 4:39824 (COO—2232A-68)
Results on correlations and jets in high transverse momentum p-p collisions at the CERN ISR, 4:39823 (COO—2232A-67)
Annett, C.H., Impact-parameter dependence of K-vacancy production in Cu-Ni collisions, 4:39799
Annis, C.G. Jr., *See* VanWanderham, M.C., 4:39137
Anthony, A.M., High temperature materials requirements of the magnetohydrodynamic energy conversion, 4:38972
Antonides, G.J., Study of SEP solar array modifications. Final report, 4:38386 (N—78-30659)
Antonov, B.M., Studies of MHD generator loading, 4:38977 (CONF-781009—, pp 543-570)
Antonov, Yu.V., Separation of gravitational and magnetic anomalies for vertical cylindrical bodies, 4:39719
Antonsen, T.M. Jr., *See* Manheimer, W.M., 4:39968
Antunes, V.T.A., Strainrange partitioning of Mar 002 over the temperature range 750°C—1040°C, 4:39138
Aoki, T., *See* Watari, T., 4:39964
Aono, S., *See* Asano, M., 4:39060
Aozaki, T., *See* Baba, K., 4:38536
Appleton, B.R., New materials properties achievable by ion implantation doping and laser processing, 4:39196 (CONF-781121—22)
Araki, T., A consideration of geothermal energy, 4:38529
Method for removing nitrogen oxides from nitrogen oxide-containing gases, 4:39353
Arend, P.V., *See* Tanabe, J., 4:40019
Arendt, J.W., Hydrogeochemical and stream sediment reconnaissance program in central United States. Semiannual progress report, October 1, 1978—March 31, 1979, 4:38222 (K/UR—21(Pt.2))
Argo, P.E., Magnetic substorms and ionospheric storms. A measurement network covering at least the entire Pacific area is seen as the key to the development of complete storm morphologies and a prediction capability. Interim report February 1976-January 1978, 4:39765 (AD-A—057975)
Ariessohn, P., Techniques for measurement of ash droplet size in coal-fired MHD flows, 4:38966 (CONF-781009—, pp 825-847)
Armantrout, G.A., Formation of thin Cu_2S (chalcocite) films using reactive sputtering techniques, 4:38394
Armbruster, J.A., *See* Mulchi, C.L., 4:38593, 4:38594, 4:38595, 4:38596, 4:38597
Arms, W.D., What Idaho Power has learned, 4:38340
Armstrong, C.M., Emission of energetic electrons from a Nd-laser-produced plasma. Interim report, 4:39985 (AD-A—059877)
Armstrong, E.L., Impact of the world's energy problems on low-head hydroelectric power, 4:38326
Arnold, C. Jr., Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND—78-0681)
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND—78-1198)
Arnott, P.T.W., *See* Goldsmith, K., 4:38709
Arora, H.S., *See* Lomenick, T.F., 4:39603
See Tamura, T., 4:38087
Asano, M., Feedback emission control for internal combustion engines with variable reference compensation for change with time in performance of exhaust composition sensor, 4:39060
Asbridge, J.R., *See* Gosling, J.T., 4:39738
Asbury, J.G., Residential electric heating and cooling: total cost of service, 4:39003 (CONF-7809138—1)
Ascoli, G., *See* Kirk, T.B.W., 4:39825
Ashley, J.C., Inverse mean free path, stopping power, csda range, and straggling in polystyrene for electrons of energy < or = 10 keV. Interim technical report, 4:39939 (AD-A—057881)
Ashworth, J., Implementation of state solar incentives: financial programs, 4:38361 (SERI/TR—51-160)
Askari, H., *See* Ruefli, T., 4:38925
Asmolovskii, V.S., *See* Gabdrakhmanov, A.G., 4:38156
Atlas, A., *See* Troia, E., 4:38446
Attalla, A., *See* Bowman, R.C. Jr., 4:39176
Atteridge, D.G., *See* Dudder, G.B., 4:39167
Atwood, J.M., Sodium technology progress report, October—December 1978, 4:38673 (HEDL-TME—78-93)
Atwood, W.B., *See* Prescott, C.Y., 4:39870
Aubrecht, G.J. II, Resonant production of high-transverse-momentum back-to-back gluon jets in pp collisions, 4:39851 (COO—1545-250)
Auer, H.E., Absorption spectrum of actinomycin D. Evidence for three transitions in the visible band, 4:39636
Auerbach, S.I., Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL—5508)
Augusta, E.L., *See* Stoering, J.P., 4:39960
Avanesov, I.G., *See* Gabdrakhmanov, A.G., 4:38156
Awes, T.C., *See* Dyer, P., 4:39925
Axelrod, M.H., *See* Anderson, O.L., 4:38121

B

Baba, K., Status of geothermal energy development in 1976, 4:38536
Babalyan, G.A., *See* Akhmetshina, I.Z., 4:38157
Babcock, J., Quantum-chromodynamic predictions for inclusive spin-spin asymmetries at large transverse momentum, 4:39867
Babcock, R.V., Cathode electrode configuration for gas laser system, 4:39299
Babu, S.P., *See* Tran, D.Q., 4:38063
Baca, P.M., *See* Granoff, B., 4:38078
Bachrach, R.Z., *See* Bauer, R.S., 4:39189
Back, B.B., *See* Dyer, P., 4:39925
Bader, B.E., DEEP STEAM Project 16 enhanced oil recovery. Quarterly report, October 1—December 31, 1978, 4:38145 (SAND—79-0562)
Baes, C.F., *See* Harris, W.F., 4:38091
Bagaria, W.J., Development of composite flywheels for energy storage and gyroscopic controls. Interim report Jul 76-Apr 77, 4:38833 (AD-A—059736)
Bagshaw, D.P., *See* Whitehouse, H.T., 4:38456
Bailey, M.E., *See* Arnold, C. Jr., 4:39191
Bain, R.L., *See* Gary, J.H., 4:38074
Bair, J., Progress on the Oak Ridge tandem, 4:39370 (LA—7445-C, pp 223-229)
Baker, G.A. Jr., Yang-Lee edge singularity in the hierarchical model, 4:39947
Baker, J., *See* O'Brien, D.W., 4:39210
Baker, M.B., *See* Charlson, R.J., 4:39536
Baker, R.R., *See* McLean, A.F., 4:39073
Baker, S., *See* Mazria, E., 4:38445
Bakish, R., Electron and ion beam science and technology, 4:39343
Baksht, R.B., Properties of cathode plasma in the diode with magnetic insulation, 4:39394 (CONF-771035—P2, pp 761-770)
Baktash, C., Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912
Balashov, A.P., *See* Mamontov, A.M., 4:39163
Balcomb, S., Solar consumer: living in a glass house, 4:38430 (CONF-780337—P2, pp 3p, Book 1, Paper 1)
Baldwin, C.E., *See* Knighton, J.B., 4:38242
Baldwin, D.E., Improved tandem mirror fusion reactor, 4:40002 (UCID—18156)
Baldwin, D.L., *See* Anantatmula, R.P., 4:40013
Baldwin, G.C., Bibliography of GRASER research. Informal report, 4:39288 (LA—7783-MS)
Baldwin, T.S., *See* Agnew, L., 4:39450
Balfour, A.E., In-situ gasification of coal. Second report on the present and future programme of the U.S. Department of Energy, 4:38062 (FE—2765-T1)
Ball, G.L., *See* Whitaker, R.B., 4:38506
Ball, J.B., Holifield Heavy Ion Research Facility. Phase II, 4:39441 (CONF-790327—3)
Ball, S.J., High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research quarterly progress report, October 1—December 31, 1978, 4:38819 (NUREG/CR—0716)
Ballard, C.P., Development of a unique pyrotechnic actuator, 4:39518 (SAND—78-1731C)
Ballou, S.W., *See* Hilton, M.L., 4:38909
Balooch, M., *See* Dooley, D., 4:39254
Balseiro, C.A., Superconductivity and ferromagnetism, 4:39957
Bame, S.J., *See* Gosling, J.T., 4:39738
Bamford, W.H., Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313—4)
Band, Y.B., *See* Morse, M.D., 4:39768, 4:39769
Bangerter, R.O., Lawrence Livermore Laboratory heavy ion fusion program, 4:40016 (UCRL—82120)
Banks, N.E., The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report, 4:39522 (AD-A—059705)

Barale, J.J., Secondary emission monitors at the Bevatron-Bevalac, 4:39457 (LBL—8808)
Barbeau, D.L., Asymmetry of apolipoprotein A-I in solution as assessed from ultracentrifugal, viscometric, and fluorescence polarization studies, 4:39643
Bareiss, E.H., Probabilistic error analysis of computer arithmetics, 4:40030 (COO—2280-37)
Baresel, D., Method of treating vehicle exhaust gas and catalyst used therein, 4:39086
Barfield, J.N., *See* Newell, R.E., 4:39767
Barish, J., *See* Alsmiller, R.G. Jr., 4:39360
Barker, G.V., *See* Halliday, L.A., 4:39030
Barkman, W.E., Interfacing the linear motor slide drive to a precision machine tool, 4:39263 (Y—2180)
Barlow, J.L., *See* Bareiss, E.H., 4:40030
Barnes, B.O., *See* Lanning, D.D., 4:38750
Barnes, D.C., *See* Freidberg, J.P., 4:39967
Barnes, J.M., *See* Ragheb, M.M.H., 4:40010
Barnes, P.D., *See* Dytman, S.A., 4:39896
Barnes, R.W., Proposed industrial energy data base for technical evaluation of alternative energy systems, 4:39028 (CONF-781244—1)
Barnham, K.W.J., *See* Gelfand, N., 4:39862
Barnthouse, L.W., *See* Brocksen, R.W., 4:39620
Barodina, T.I., *See* Telegin, G.P., 4:38967
Baroni, G., *See* Read, A.L., 4:39821
Barr, F.P., *See* Carpenter, R.L., 4:39599
Barrett, R.J., *See* Anderson, B.D., 4:39906
Bartel, L.C., Use of electrical geophysical techniques to map and monitor in situ oil shale recovery processes, 4:38192 (SAND—79-0746C)
Bartine, D.E., *See* Burns, T.J., 4:39460
Bartlett, J.W., Information base for waste repository design. Volume 7. Executive summary, 4:38270 (NUREG/CR—0495(Vol.7))
Barton, G.W., *See* Boyle, W.G., 4:39204
Baryshev, N.S., *See* Mamontov, A.M., 4:39164
Bashkin, A.S., Chain-reaction chemical lasers for the visible range, 4:39305
Gain measurement in a supersonic jet utilizing a $D+O_3+CO_2$ mixture, 4:39317
Investigation of the energy parameters of a chemical ClF—H_2 laser with electron-beam initiation, 4:39318
Utilization of excited atoms in thermally initiated chemical lasers in the visible range, 4:39304
Basmajian, J.A., *See* Hollenberg, G.W., 4:38754
Basov, N.G., Synchronization of electron-beam-controlled CO_2 lasers with a plasma mirror, 4:39311
Bassompierre, G., *See* Read, A.L., 4:39821
Bastin, J.J., Application of advanced accountability concepts in mixed oxide fabrication, 4:38228 (WCAP—9104)
Impact of receipt of coprocessed uranium/plutonium on advanced accountability concepts and fabrication facilities. Addendum 1 to application of advanced accountability concepts in mixed oxide fabrication, 4:38229 (WCAP—9104(Add.1))
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP—9104(Add.2))
Bastl, W., *See* Dio, W.H., 4:38629
Bates, J.L., *See* Marchant, D.D., 4:38971
Bates, S.C., *See* Murakami, M., 4:39970
Bauch, T.D., *See* Schiff, M., 4:38448
Bauer, K., Prediction and indication of process states as aids in power plant control technology, 4:38570 (NP—23706)
Bauer, R.S., Bonding at the Si (111)—SiO_2 interface: stoichiometry and kinetics probed with synchrotron radiation photoemission spectroscopies, 4:39189
Baugnet, J.M., General outline of the operation and utilization of the BR2 reactor, 4:38783 (INIS-mf—4426, pp XIII.1-33)
Baum, S.J., Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A—059749)
Baumgardner, R.E., *See* Mulik, J.D., 4:39560
Baumgartner, H., Process and apparatus for controlled recycling of combustion gases, 4:39349
Baxman, C.I., Applied nuclear data research and development. Progress report, October 1—December 31, 1978, 4:39879 (LA—7722-PR)
Baybutt, P., *See* Gieseke, J.A., 4:38816, 4:38817
Bayer, A., Consequence model of the German reactor safety study, 4:38824 (SAND—78-2074C)
Bayfield, J.E., Development and testing of a three-stage double tandem accelerator-decelerator system for low energy, highly stripped ions. Progress report, March 1, 1978—February 28, 1979, 4:39978 (COO—4257-3)
Bazerghi, H., Estimation and reduction of errors in flow measurements which use cross-correlation techniques, 4:38741
Beard, S.G. Jr., *See* Sheldahl, R.E., 4:39179
Beason, D.G., *See* Parks, D.J., 4:39255
Beason, F.L., Solar assisted heat pump study for heating of military facilities. Final report, July 1976-November 1977, 4:38415 (AD-A—058626)
Beatley, J.C., Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963—1975, 4:39607 (DOE/EV—2307-15)
Beaton, M.S., *See* Dicks, J.B. Jr., 4:38957
Beatty, R.L., *See* Lotts, A.L., 4:38227
Beazley, R., A benefit-cost system of decision making for strip mined land reclamation in Illinois, 4:38093 (PB—285447)
Bechtold, I.C., Method for producing hydrocarbons from igneous sources, 4:38317
Becker, D.E., Vent-air monitoring in nuclear power plants by a nuclide-specific detection system, 4:38742
Becker, M., *See* Bokharee, S.A., 4:39444
Becker, R.L., Theory of electron transfer and ionization, 4:39789 (CONF-790438—1)
Beeler, J.R. Jr., Radiation-induced defect production in structural materials at reactor temperatures, 4:39166 (EUR—5667(Pt.2), pp 1-23)
Beeler, M.F., *See* Beeler, J.R. Jr., 4:39166
Beeson, J.L., *See* Duncan, D.A., 4:38075
Begley, R.F., High-resolution spectroscopy measurements of the $^{12}CF_4$ $\nu_2 + \nu_4$ band at 9 μm, 4:39237 (LA—7542)
Bekefi, G., *See* Orzechowski, T.J., 4:39341
Bela, A., *See* O'Hara, J.B., 4:38051
Bell, A.T., Catalytic synthesis of hydrocarbons, 4:38316 (LBL—8975, pp 64.-66.)
Bell, J.T., *See* Toth, L.M., 4:39253
Bellows, A., Design, fabrication and field testing of remotely operated longwall head/tail supports. Final report, 4:38101 (PB—285041)
Bendel, W.L., *See* Ensslin, N., 4:39890
Bender, C.F., *See* Hackel, L.A., 4:39787
Bender, D.E., *See* Kirk, T.B.W., 4:39825
Bender, N., *See* Hofer, G., 4:39131
Benedick, W.B., *See* Buxton, L.D., 4:38823
Benemann, J.R., Recent developments in hydrogen production by microalgae, 4:38310
Benezech, G., *See* Miribel, J., 4:38738
Benjamin, B.M., *See* Collins, C.J., 4:38071
Benson, S.M., *See* Narasimhan, T.N., 4:38546
Benziger, T.M., Thermally stable, plastic-bonded explosives, 4:39521
Benzley, S.E., *See* Lieberman, M.L., 4:39519
Berger, R., *See* Le Guillou, G., 4:38695
Berger, X., *See* Schneider, M., 4:38461
Bergknoff, H., Lattice-gauge-theory spectrum for broken SU(4), 4:39837
Berk, J.V., *See* Hollowell, C.G., 4:38995
Berkovskii, B., Power production and its potential influence on the global climate, 4:39593
Bernal, E.L., Multiple application coded switch development report, 4:39260 (SAND—79-0329)
Bernard, P., Neutron noise measurements on pressurized water reactors, 4:38635
Bernasek, S.L., Chemical poisoning in heterogeneously catalyzed reactions, 4:39239 (LBL—8975, pp 23.-24.)
Berriaud, C., Study of the effect of hard projectiles impacting reinforced concrete walls, 4:38793 (CEA-CONF—4035)
Berry, H.G., *See* Gay, T.J., 4:39778
Berry, S.M., Spent unreprocessed fuel (SURF) facility evaluation plan of the alternative storage concepts, 4:38247 (RHO-CD—271)
Berzon, I.S., Seismic surveys by reflected waves on the Russian platform, 4:39713
Beutler, P.S., *See* Chan, A.I.Y., 4:38780
Bevan, J.L., *See* Anantatmula, R.P., 4:40013
Beveridge, J.H., *See* Linhardt, H.D., 4:38046
Bevington, P.R., *See* Anderson, B.D., 4:39906
Beyer, J.B., *See* Scharer, J.E., 4:39966
Beymer, J.R., *See* Adamski, J.L., 4:39381
Bezgachev, E.A., *See* Andreev, A.M., 4:38683
Bhar, T.N., *See* Singh, R., 4:38395
Bhattacharjee, A., *See* Strachan, J.D., 4:39977
Bhattacharya, S., Anisotropic ultrasound propagation in a smectic-A liquid crystal, 4:39194
Ultrasonic study of a smectic-B liquid crystal, 4:39193
Bhide, V.S., *See* Douglass, D.L., 4:38068
Bianconi, A., *See* Bauer, R.S., 4:39189
Bickham, R.E., *See* Sanyal, S.K., 4:38524
Biggerstaff, J.A., *See* Moak, C.D., 4:39170
Biggs, F., Helios model for the optical behavior of reflecting solar concentrators, 4:38496 (SAND—76-0347)
Billen, D., Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N'-nitro-N-nitrosoguanidine, 4:39642
Billinge, R., Proposed p-anti p colliding beam facility at CERN, 4:39411 (LBL—7574, pp 82-86)
Billquist, P., Installation of NEC tubes in the Argonne National Laboratory FN, 4:39363 (LA—7445-C, pp 61-83)

Birkelund, J.R., *See* Huizenga, J.R., 4:39932
Birmingham, T.J., *See* Schardt, A.W., 4:39759
Birmontas, A., Fluctuations of the energy and duration of Q-switched picosecond YAG:Nd^{3+} laser radiation, 4:39307
Birnbaum, H.K., *See* Brun, T.O., 4:39174
See Kajitani, T., 4:39175
Birnboim, H.C., Prevention of G:C pairing in mouse DNA by complete blocking of guanine residues with glyoxal. Availability of cytosine, adenine and thymine for hydrogen bonding with added unmodified polynucleotides, 4:39646
Bischofberger, T., Theoretical and experimental study of the dynamic behavior of a nonlinear Fabry-Perot interferrometer, 4:39513
Bischoff, W.S., Geothermal Loop Experimental Facility. Quarterly report, April—June 1978, 4:38540 (SAN—1137-11)
Geothermal Loop Experimental Facility. Quarterly report, January—March 1978, 4:38543 (SAN—1137-10)
Biserna, T., Results of acoustic and temperature noise measurements on sodium cooled electrically heated 7 rod bundle, 4:38691
Bishop, H.K., *See* Bischoff, W.S., 4:38540, 4:38543
Bishop, T.A., *See* Collier, R.P., 4:38815
Biswas, R., Solvent refined coal (SRC) process. Research and development report No. 53. Interim report No. 23, 1976—1977. Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 11. Processing of solvent refined coal minerals, 4:38073 (FE—0496-T14)
Bitiurin, V.A., Numerical modeling of MHD generator operation in an MHD power plant operating at part load, 4:38955 (CONF-781009—, pp 161-217)
See Antonov, B.M., 4:38977
Bitter, M., Dielectronic satellite spectrum of helium-like iron (Fe XXV), 4:39973 (PPPL—1538)
Bittner, J., *See* Krinsky, S., 4:39468
Bjorstad, P., Extrapolation of asymptotic expansions by a modified Aitken δ^2-formula, 4:40043 (SU—326-P30-61)
Black, W.C. Jr., *See* Derbenwick, G.F., 4:39338
Blackburn, P.E., *See* Johnson, T.R., 4:38962
Blackfield, D.T., *See* Scharer, J.E., 4:39966
Blackwood, T.R., Source assessment: coal storage piles. Final task report May 1974-September 1975, 4:38092 (PB—284297)
See Ochsner, J.C., 4:39567
Blaes, G., *See* Read, A.L., 4:39821
Blair, H.T., *See* Larson, D.E., 4:38255
Blanchart, A.P.O., Electrochemical zinc—oxygen cell, 4:38858
Bland, R., Offshore vessel traffic management (OVTM) study. volume i. executive summary. Final report Aug 77-Jun 78, 4:38172 (AD-A—059655)
Bland, R.A., *See* Lee, S.S., 4:39627
Blasing, T.J., *See* Harris, W.F., 4:38091
Blazowski, W.S., Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN—1543-12)
Bleiler, K.W., *See* Zavitsanos, P.D., 4:38045
Bleser, E., *See* McInturff, A.D., 4:39473
Bliss, C., Proceedings of the fifth international conference on fluidized bed combustion. Volume 1: overview, 4:38125 (M—78-68(Vol.1))
Bliss, R.J., *See* Hard, E.N., 4:38778
Block, D.A., Earth-integrated direct gain residence using concrete cored slab, 4:38469 (IS-M—192)
Block, R.C., *See* Bokharee, S.A., 4:39444
Bloom, J.A., Decomposition and probabilistic simulation in electric utility planning models. Technical report, 4:38609 (AD-A—058421)
Blue, J.W., Targets for producing high purity I-123, 4:39465
Bluemle, J., Operation and utilization of the FR2 in 1977. Abbreviated version, 4:38784 (KFK-EXT—15/78-1)
Blumberg, L., *See* Krinsky, S., 4:39468
Blumberg, L.N., *See* Weng, W.T., 4:39429
Blumenfeld, B.J., *See* Angelis, A.L.S., 4:39823, 4:39824
Blumenthal, D.L., *See* White, W.H., 4:39575
Blumkin, S., Minor isotope measurements for safeguarding a uranium enrichment plant, 4:38290 (K/OA—4488)
Boade, R.R., *See* Reed, R.P., 4:38189
Bobis, J.P., *See* Carey, W.M., 4:38698
Bobula, C.M. III, *See* Holtzman, R.B., 4:39600
Boehm, H., Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T—78-08)
Boercker, S.W., Energy use in the production of primary aluminum, 4:38939
Boersma, L., Management of swine manure for the recovery of protein and biogas. Final report, 4:38318 (PB—286722)
Bogle, M.A., *See* Bondietti, E.A., 4:39602
Boiko, V.A., *See* Basov, N.G., 4:39311
Bokharee, S.A., Photoneutron target design for fast neutron spectrum measurements, 4:39444 (COO—4933-1)
Bol, K., *See* Dylla, H.F., 4:40024
See Hawryluk, R.J., 4:39980
Boldt, E.A., *See* Mushotzky, R.F., 4:39741
See Pravdo, S.H., 4:39740
Boley, B.A., *See* Jaeger, T.A., 4:38625, 4:38632, 4:38740, 4:38804, 4:38805, 4:38806, 4:38969, 4:39107, 4:39108, 4:39109, 4:39110, 4:39111, 4:39112, 4:39113, 4:39114, 4:39115, 4:39116, 4:39117, 4:39118, 4:39119, 4:39120, 4:39121, 4:39122, 4:39123, 4:39124, 4:39125, 4:39126, 4:39127, 4:39161
Bomar, G.B., *See* Maguire, C.F., 4:39902
Bond, D.C., Study of the potential for future work on methods of determining residual oil. Final report, 4:38139 (BETC—0007-3)
Bond, G.N., *See* Harrison, T.D., 4:38498
Bond, V.P., *See* McNulty, P.J., 4:39666
Bondietti, E.A., Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL—5508, pp 49-64)
Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc, 4:39601 (CONF-781105—100)
Bonner, W.F., *See* Larson, D.E., 4:38255
Boom, R.W., *See* Peterson, H.A., 4:38831
Boopathy, C., Computer supervision of the core outlet sodium temperatures of FBTR, 4:38699
Booth, R., Strong focus electrostatic lens, 4:39464
See Lefevre, H.W., 4:39423
Booth, W.G., Coal cutter vehicle, 4:38122
Bopp, L.H., *See* Chakrabarty, A.M., 4:39644
Borden, C.S., *See* Lavin, M.L., 4:38097
Borders, J.A., Analysis of coatings and thin films using energetic ions, 4:39177 (SAND—79-2076C)
Borkan, W.N., Energy monitor and control system, 4:39015
Borodulin, V.I., Distributed-feedback semiconductor lasers operating in higher Bragg interaction orders, 4:39316
Borst, H., *See* Becker, D.E., 4:38742
Botts, T.E., Laser-particulate control for open-cycle, coal fired gas turbines, 4:38601 (BNL—25587)
Bottum, E.W., Combined heat pump system and ice making system, 4:3[illegible]00
Botz, M.K., *See* Schmidt, J., 4:39619
Boudrie, R.L., *See* DiGiacomo, N.J., 4:39907
Bougaev, S.P., *See* Baksht, R.B., 4:39394
Bourdeau, L., *See* Schneider, M., 4:38461
Bourke, P.J., Heat transfer aspects of underground disposal of radioactive waste, 4:38259 (AERE-R—8790)
Bourrieau, J., Proton and electron irradiation of thermal control coatings and polymeric films. II. Theoretical irradiations. Final report, 4:39185 (N—78-31253)
Bovard, P., Fine gamma spectrometry and release measurements, 4:39495
Bowman, J.D., Upper limit for the decay $\mu^+ \rightarrow e^+\gamma$, 4:39818
Bowman, K.O., *See* Shenton, L.R., 4:40047
Bowman, R.C. Jr., Proton magnetic resonance studies of TiCuH, 4:39176
Boyarski, A.M., *See* Heile, F.B., 4:39846
Boyle, J.T., *See* Spence, J., 4:38749
Boyle, W.G., Automating the Analytical Laboratories Section, Lewis Research Center, National Aeronautics and Space Administration: a feasibility study, 4:39204 (UCRL—52594)
Bradbury, J., *See* Paciotti, M., 4:39453
Bradley, B.P., Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB—286113)
Bradley, E.B., *See* Reucroft, P.J., 4:38056, 4:38057
Bradley, E.F., *See* Sheih, C.M., 4:39511
Brainard, J.P., Dielectric stimulated arcs in lightning arrestor connectors, 4:38614 (SAND—79-0396C)
Brandhorst, H., *See* Costogue, E.N., 4:38378, 4:38379
Brandt, H.E., Microwave generation in the reflex triode, 4:39424 (CONF-771035—P2, pp 649-661)
Brantley, J.N., *See* Bondietti, E.A., 4:39602
Bray, J.A., *See* Melhuish, K.R., 4:38690
Brehany, J.J., *See* Wilson, E.M., 4:39047
Brehm, W.F., *See* Anantatmula, R.P., 4:40013
Breidenbach, M., *See* Heile, F.B., 4:39846
Brenchley, D.L., *See* Cone, B.W., 4:38912
Breslin, A., *See* Read, A.L., 4:39821
Bretz, N., *See* Hawryluk, R.J., 4:39980
Breuer, H., *See* Dyer, P., 4:39925
Brewer, G.D., Study of fuel systems for LH2-fueled subsonic transport aircraft. Volume 1. Final report, September 1976—December 1977, 4:39017 (N—78-31085)
Study of fuel systems for LH2-fueled subsonic transport aircraftVolume 2. Final report, September 1976—December 1977, 4:39018 (N—78-31086)
Bridges, J., Method for in situ heat processing of hydrocarbonaceous formations, 4:38195
Bridwell, L.B., *See* Knudsen, H., 4:39940
Brigham, W.E., *See* Yuen, D.L., 4:38133
Brillon, A., *See* Bernard, P., 4:38635
Brissaud, I., *See* DiGiacomo, N.J., 4:39907

Britt, H.C., Experimental survey of the potential energy surfaces associated with fission, 4:39938 (LA-UR—79-533)
Britvin, A.I., *See* Volovik, A.V., 4:38961
Brix, V.L., *See* Cone, B.W., 4:38912
Brock, H.W., Large-scale energy planning models: a methodological analysis. Final report, 4:38863 (PB—285642)
Brocksen, R.W., Aquatic Ecology Section, 4:39620 (ORNL—5508, pp 79-91)
Brodsky, S.J., Production of jets and single particles at large transverse momentum in photon-photon collisions, 4:39842
Quantum chromodynamics and the dynamics of hadrons, 4:39856 (SLAC-PUB—2298)
Brog, P.E., Calculation of cooling tower plumes with KUMULUS, 4:39590
Brogan, T.R., Design of a single output MHD generator for the USSR U-25 installation, 4:38973 (CONF-781009—, pp 222-246)
Bromborsky, A., *See* Brandt, H.E., 4:39424
Bromley, D.A., *See* Phillips, R.L., 4:39886
Brosset, C., Role of ammonia in the chemistry of atmospheric aerosols, 4:39543 (IVL-B—449)
Browman, A.A., *See* Frank, J.S., 4:39832
Brown, C.H. Jr., Mass transfer in two-phase nondispersing liquid—liquid contactors with a high-density-difference system, 4:39215 (ORNL/TM—6670)
Brown, C.N., *See* Vidal, R., 4:39828
Brown, D., *See* McInturff, A.D., 4:39473
Brown, D.B., Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A—058697)
Brown, F.C., *See* Wakabayashi, N., 4:39190
Brown, F.R., Vibrational spectroscopic studies of coal conversion catalysts, 4:38065 (LBL—8975, pp 77.-78.)
Brown, H., *See* Weng, W.T., 4:39469
Brown, H.N., *See* Allinger, J., 4:39436
Brown, K.L., *See* Servranckx, R.V., 4:39485
Brown, R.A., Nickel—zinc battery for aircraft and missile applications. Final report 14 Feb 75-14 Feb 78, 4:38845 (AD-A—059295)
Brown, R.E., *See* Flynn, E.R., 4:39904
Brown, R.J., *See* Barkman, W.E., 4:39263
Brown, R.M., *See* Michael, P., 4:39540
Brown, S.L., Systems for rapid ranking of environmental pollutants: selection of subjects for scientific and technical assessment reports. Final report, 4:39553 (PB—284338)
Brown, T.G., *See* Armantrout, G.A., 4:38394
Brown, W.C., Design, fabrication and testing of a CFA for use in the solar power satellite. Final report, 4:38404 (N—78-31143)
Brown, W.K., Model of the formation of elliptical galaxies, 4:39755
Browne, J.C., Review of the microscopic cross sections for the americium isotopes in the resolved resonance region, 4:39923 (UCRL—81909)
Browning, J.S., Recovering fine-size coal from Alabama underground mine washer wastes using the Humphreys spiral, 4:38119 (FE—9005-T1)
Brudnoy, D.M., *See* Beeler, J.R. Jr., 4:39166
Brues, A.M., Recent cases of radium-induced malignancy, 4:39671 (ANL—78-65(Pt.2), pp 1-4)
Brugger, R.M., *See* Tsang, F.Y., 4:39910
Brun, T.O., Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341—3)
See Kajitani, T., 4:39175
Brunet, M., *See* Le Guillou, G., 4:38695
Brunner, J.A., *See* McCone, A.I., 4:38566
Bruns, H.B., *See* Brandt, H.E., 4:39424
Brunton, G.D., Low-Temperature Thermal Energy Storage Program. Annual progress report, October 1977—September 1978, 4:38837 (ORNL/TM—6701)
Bryce, A.J., Review of the energy from Marine Biomass Program, 4:38320
Brzozka, E., Development trends in remote control systems used in Soviet mining, 4:38096
Buchanan, V., ISABELLE magnet support and adjustment system, 4:39472 (BNL—25799)
Buckner, A.T., *See* Cady, W.E., 4:39182
Bucy, J.I., Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974—June 1977, 4:39045 (PB—284200)
Budimir, J., *See* Lefrois, R.T., 4:38836
Buenerd, M., *See* Gelbke, C.K., 4:39915
Bulanov, N.A., Frequency distortions in a multistrand cable during electrical surveying of wells, 4:38136
Bunch, R., Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL—81879)
Bunnell, K., *See* del Papa, C., 4:39816
Bunting, R.L., *See* Dyer, N.C., 4:38633
Burakov, V.S., Diagnosis of high-temperature hydrogen plasma by the resonance fluorescence method, 4:39975
Burenkov, D.K., Study of the influence of a slag film on the characteristics of electrodes in the MHD generator channel of the U-02 facility, 4:38974 (CONF-781009—, pp 247-269)
Burgess, R.L., Environmental Resources Section, 4:40051 (ORNL—5508, pp 102-116)
Burginyon, G.A., *See* Stoering, J.P., 4:39960
Burhop, E.H.S., *See* Read, A.L., 4:39821
Burkart, K., *See* Bayer, A., 4:38824
Burke, A., *See* Dowdy, M., 4:39054, 4:39063
Burke, D.G., *See* Loehoeiden, G., 4:39913
Burleson, G.R., *See* Dytman, S.A., 4:39896
Burleson, R.R., Interferometric correction system for a numerically controlled machine, 4:39265
Burnell, L.K., Control of nitrogen oxides from stationary source effluents, 4:39356
Burns, B., *See* Mason, B., 4:38367
Burns, E.J.T., *See* Johnson, D.J., 4:39780
Burns, R.E., Disposal of radioactive iodine in space, 4:38263 (N—78-31740)
Burns, T.J., Concept evaluation of a nuclear design for electronuclear fuel production: evaluation of ORNL's proposed TMF—ENFP, 4:39460 (ORNL/TM—6828)
Burwell, R.L. Jr., *See* Butt, J.B., 4:39226
Buschbach, T.C., New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR—0450)
Bush, C.E., *See* Murakami, M., 4:39970
Bush, T.W., Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1—June 30, 1978, 4:38080 (FE-MIT—2295T26-6)
Buss, R.J., Molecular beam studies of unimolecular reactions: Cl, F + C_6H_5Br, 4:39794 (LBL—7686)
Butcher, W.R., Need for better forecasting, 4:38935
Butler, C.F., *See* Mills, F.S., 4:39546
Butt, J.B., Properties of supported metal catalysts, 4:39226 (LBL—8975, pp 49.-51.)
Buttermore, W., Effects of minerals on coal beneficiation processes. Quarterly report No. 3, April 1—June 30, 1978, 4:38118 (FE—2722-3)
Buttermore, W.H., Utilization of coal associated minerals. Quarterly report No. 2, January—March 1978, 4:38086 (FE—2721-2)
Buttram, M.T., Operation of repetitively pulsed 300 kV, 20 kA electron beam diode, 4:39461 (SAND—79-0596C)
Buxton, L.D., Steam explosion triggering and efficiency studies, 4:38823 (SAND—78-0261C)
Buznikov, A.E., Studies of diagonal MHD channels at the U-25 facility during duration operation, 4:38976 (CONF-781009—, pp 347-380)
See Antonov, B.M., 4:38977
Buzzard, R.J., Laser plasma tube having internal gas path, 4:39302
Buzzi, J.M., Microwave generation and frequency conversion using intense relativistic electron beams, 4:39332 (CONF-771035—P2, pp 663-673)
Bygorvskii, V.F., *See* Korsakov, V.S., 4:38623
Bykovskii, Y.A., *See* Borodulin, V.I., 4:39316
Byrne, R.J., Information base for waste repository design. Volume .4 Mine structural features, 4:38267 (NUREG/CR—0495(Vol.4))
Bystry, A.I., Diagnostics of combustion products plasma based on its fluctuation characteristics, 4:38979 (CONF-781009—, pp 749-772)

C

Cacic, C.G., *See* Larsen, R.P., 4:39688
Cadle, R.D., Structure, composition and distribution of stratospheric aerosol particles and their radiative properties and importance for the radiation budget, 4:39576
Cady, W.E., Development of alternate silicone potting compounds. Vol.4. Development of a substitute for Dow Corning's aerospace sealant DC 93-120 resin cured with DC 93-122 curing agent, 4:39182 (UCRL—52434(Vol.4))
Cain, D.G., *See* Chow, M.C., 4:38755
Caldwell, D.O., Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
Callender, J., Structural petrology of undeformed and experimentally deformed halite samples from USERDA site No. 7 and No. 9, 4:39726 (SAND—78-7076)
Calzonetti, F.J., Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA—12)
Campbell, D., Electronics of the target diagnostics system for the Shiva Laser Fusion Facility, 4:40014 (UCRL—52521)
See Glaros, S.S., 4:40021
Campbell, G.M., Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA—7785-MS)
Campo, J.G.d., *See* Moak, C.D., 4:39170
Cance, M., Absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu at 13.9 and 14.6 MeV, 4:39927
Cannaday, S.S., *See* Fogdall, L.B., 4:39197
Cannon, T.M., *See* Fenimore, E.E., 4:39490

Carey, W.M., Detection of sodium vapor bubble collapse in a liquid metal fast breeder reactor, 4:38698
Carlson, D.E., Amorphous-silicon solar cells. Annual report, July 1, 1976—June 30, 1977, 4:38392 (SAN—1286-4)
Carlson, P.S., Genetic modification and plant productivity, 4:39651
Carpenter, P.R., Economic analysis of grid-connected residential solar photovoltaic power systems, 4:38377 (MIT-EL—78-007)
Carpenter, R.L., Microprocessor-controlled inhalation system for repeated exposure of animals to aerosols, 4:39599
Carr, P., Operational zinc chlorine battery based on a water store, 4:38844
Carr, W.J. Jr., Superconductive winding for an iron core rotor of a dynamoelectric machine, 4:39272
Carre, J.C., *See* Bernard, P., 4:38635
Carreras, B., *See* Waddell, B.V., 4:39992
Carrington, R.L., *See* Bowman, J.D., 4:39818
Carroll, A.S., *See* Allinger, J., 4:39436
Carroll, D.P., Security assessment of power systems including energy storage. Progress report, April 1—June 30, 1978, 4:38610 (COO—4206-5)
Carroll, J., *See* Stetz, A., 4:39847
Carsten, A.L., Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL—25730)
See Slatkin, D.N., 4:39692
Carstens, D.H.W., Stability of the lanthanide hydrides, 4:39221 (LA—7602-MS)
Cartland, W.H., Solar heater freeze protection system, 4:38483
Caruvana, A., Development of high temperature turbine subsystem technology to a "technology readiness status", phase II. Progress report, March 1979, 4:38579 (FE—1806-65)
Casey, G.L., Electric fuel injection valve, 4:39068
Casten, R.F., Unique parity states in ^{109}Pd from the (n,γ) reaction: calculations for rotation aligned and odd mass IBA models, 4:39908 (BNL—25877)
Castle, J.G. Jr, Measurements of material properties for solar cells. Final report, 7 February 1977—6 March 1978, 4:38388 (N—78-31531)
Cataldo, D.A., Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL—2740)
Cate, J.H., *See* Start, G.E., 4:38763
Catling, E., *See* Macleod, I.D., 4:38696
Cattaneo, L.E., *See* Waksman, D., 4:38494
Cavagnaro, D.M., Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 1. 1964-1976 (a bibliography with abstracts). Report for 1964-1976, 4:39206 (NTIS/PS—78/1241)
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 2. 1977-november, 1978 (a bibliography with abstracts). Report for 1977-Nov 78, 4:39207 (NTIS/PS—78/1242)
Electrochemical reactions at surfaces. Volume 1. 1964-1975 (a bibliography with abstracts). Report for 1964—75, 4:39247 (NTIS/PS—78/1033)
Electrochemical reactions at surfaces. volume 2. 1976—September, 1978 (a bibliography with abstracts). Report for 1976—September 1978, 4:39248 (NTIS/PS—78/1034)
Cavaleri, L., Preliminary considerations on wave motion measurements. enel's wave meter network, 4:38561
Cavallini, F., *See* Biserna, T., 4:38691
Cavin, O.B., *See* Harris, L.A., 4:38082
Celmaster, W., Lepton-width suppression of vector-meson decays, 4:39843
Ceradini, F., *See* Read, A.L., 4:39821
Cerbone, R.J., *See* Agrawal, A.K., 4:38812
Cerf, J., *See* Miribel, J., 4:38738
Cerling, T.E., *See* Lomenick, T.F., 4:39603
Cermak, V., The map of heat flow in Europe and its role in the preliminary evaluation of the sources of geothermal energy, 4:38521
Chahroudi, D., Engineering design for thermocrete central storage units for low temperature solar application. Monthly technical report, August—September 1978, 4:38505 (COO—4702-3)
Chai, V.W., *See* Lansing, F.L., 4:38996
Chakrabarty, A.M., Transposition of plasmid DNA segments specifying hydrocarbon degradation and their expression in various microorganisms, 4:39644
Chamberlain, O., *See* Lemaire, M.C., 4:39887
Chamberlain, T.W., Performance characteristics of automotive engines in the United States. First series - Report No. 15. 1975 Dodge Colt 98 CID (1.6 liters), 2v. Interim report, August 1977, 4:39065 (PB—286075)
Performance characteristics of automotive engines in the United States. Second series - Report No. 5. 1977 Ford 140 CID (2.3 liters), 2v. Interim report, November 1977, 4:39066 (PB—286076)
Chamow, M.F., *See* Cutting, J.C., 4:38947
Chan, A.I.Y., Material compatibility tests for LOFT nuclear reactor fuel centerline thermocouples, 4:38780 (NUREG/CR—0643)
Chan, H.C., *See* Sigmar, D.J., 4:39982
Chance, L.A., Chemistry of the PSGHWR heavy water moderator system, 4:38643
Chang, C.H., Cells having cathodes containing C/sub s/S cathode-active materials, 4:38856
Chapman, T.C., Fission product yields from 6—9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis, 4:39926 (AD-A—059327)
Chapus, E.E., Bulb units for low-head hydroelectric generation, 4:38336
Charlson, R.J., Dominance of tropospheric sulfate in modifying solar radiation, 4:39536
Charlton, L.A., Polarizability of nuclear wave functions in heavy ion reactions, 4:39937
Chasman, R.R., Coherent residual interactions: pairing plus particle-hole, 4:39929
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
See Ahmad, I., 4:39920
Chaturvedi, L., *See* Gunaji, N.N., 4:38550
Chaturvedi, P.K., *See* Huba, J.D., 4:39761
Chebotarev, N.F., *See* Bashkin, A.S., 4:39318
See Kolchin, Y.A., 4:39314
See Kozlov, Y.I., 4:39315
Chechetkin, Y.V., *See* Gryazev, V.M., 4:38682
Chen, H.H., Economics of low-head hydro: US case studies, 4:38344
Chen, M., *See* Rao, S.T., 4:39558
Chen, S., Scaled Boltzmann theory for k-dependent test particle correlation functions in moderately dense gases), 4:39961
Chen, S.S., *See* Nahavandi, A.N., 4:38662
Chiba, G., *See* Baba, K., 4:38536
Chikovani, V.V., Comparison of conjugate cyles of power and refrigerating installations, 4:39267
Childs, C.B., Passive particle dosimetry. Final report, 17 November 1970—30 June 1977, 4:39493 (N—78-27965)
Childs, D.L., Study of set-theoretic information processing, 4:38859 (UCRL—13970)
Chirapatpimol, N., *See* Stetz, A., 4:39847
Chisum, G.T., Laser eye protection for flight personnel. Volume I. Phase report, 4:39698 (AD-A—057417)
Chiu, T-H., *See* Nyilas, E., 4:39652
Choe, J.Y., Stability properties of an anisotropic guiding center plasma and relation with the Suydam function, 4:39990
Chopra, A.K., *See* Lee, M.C., 4:38826
Chow, L.S.H., *See* Johnson, T.R., 4:38962
Chow, M.C., Malfunction detection of nuclear reactor by dynamic data system methodology, 4:38755
Christensen, B., *See* Stauning, P., 4:39763
Christensen, U.R., *See* Weissenburger, D.W., 4:40008
Christman, P.G., *See* Noblett, J.G., 4:38571
Christoffersen, R.E., *See* Spangler, D., 4:39804
Christophorou, L.G., Negative ions of polyatomic molecules, 4:39783 (CONF-790344—1)
Chu, E., *See* Salvesen, K.G., 4:39565
Chu, F.Y.F., *See* Karney, C.F.F., 4:39999
See Pereira, N.R., 4:39998
Chu, K.R., *See* Sprangle, P., 4:39336
Chu, W.T., *See* Alonso, J.R., 4:39459
Chugunov, A.Y., *See* Basov, N.G., 4:39311
Churchill, B.R., *See* Frost, C.R., 4:38647
Churukian, C.J., *See* Moosavi, H., 4:39650
Chye, P.W., *See* Lindau, I., 4:39953
Ciaramitaro, W., *See* Gopal, R., 4:38636
Cinco-L, H., *See* Yuen, D.L., 4:38133
Cirrito, A.J., Apparatus for hot gas heat transfer particularly for paper drying, 4:39042
Claiborne, H.C., United States program for the safety assessment of geologic disposal of commercial radioactive wastes, 4:38276
Clapp, N.K., *See* Davidson, K.A., 4:39648
Clark, A.F., *See* Edelsack, E.A., 4:39955
Clark, G., Estimation of atmospheric radiation for clear and cloudy skies, 4:38357 (CONF-780337—P3, pp 4p, Book 1, Paper 7)
Clark, W.E., Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM—6672)
See Lin, K.H., 4:38250
Claudson, M., Model-independent determination of hadronic neutral-current couplings, 4:39848
Claus, J., Status of ISABELLE lattice, 4:39471 (BNL—25798)
See Weng, W.T., 4:39469
Clauser, M.J., *See* Farnsworth, A.V. Jr., 4:40017
Clausing, R.E., Versatile UHV sample transfer system, 4:40022
See Emerson, L.C., 4:40027
Cleary, M.P., *See* Hanson, M.E., 4:38181
Cleary, T.P., Implementation of the ORIC magnetic field measurements, 4:39442 (CONF-790327—8)
Cleveland, J.C., *See* Ball, S.J., 4:38819
Clifford, J.M., *See* Forrest, L., 4:39056
Clifford, P., *See* Goldgraben, G.R., 4:39564
Clift, R., *See* Doganoglu, Y., 4:39350
Cline, D., Anti p production characteristics and collection systems, 4:39414 (LBL—7574, pp 106-111)
Collecting anti protons in the Fermilab Booster and very high energy proton-

anti proton interactions. Appendix C, 4:39422 (LBL—7574, pp 325-398)
Cline, D.B., High luminosity anti pp machines: the physics goals, 4:39477 (LBL—7574, pp 31-49)
Cline, T.B., Descriptor variable representation of large-scale deterministic systems, 4:38864 (TID—29389)
Clink, G.L., FE-NMR analysis of silane hydrogen, phenyl, and vinyl content of several siloxane pre-polymer materials, 4:39200 (MHSMP—79-15)
Close, E., Proposed orbit and vertical dispersion correction system for PEP, 4:39483 (SLAC-PUB—2265)
Clough, R.W., *See* Lee, M.C., 4:38826
Cnops, A.M., Neutrino—deuterium reactions in the 7-foot bubble chamber, 4:39819 (BNL—24848)
Cocke, C.L., *See* Annett, C.H., 4:39799
Cockerell, C., Apparatus for extracting energy from wave movement of the sea, 4:38557
Coffey, H.E., Solar—geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB—285773)
Solar—geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB—285774)
Coggiola, M.J., *See* Buss, R.J., 4:39794
Cohen, J.B., *See* Butt, J.B., 4:39226
Cohen, M.L., *See* Ho, K.M., 4:39157
See Louie, S.G., 4:39159
See Pickett, W.E., 4:39156
Cohen, S.A., *See* Dylla, H.F., 4:40024
See Rossnagel, S.M., 4:39152
See Wampler, W.R., 4:40006
Colburn, C., *See* Crumrine, K., 4:39596
Colchin, R.J., *See* Murakami, M., 4:39970
See Simpkins, J.E., 4:40026
Cole, J., Channel development for coal fired MHD, 4:38975 (CONF-781009—, pp 271-346)
Collier, R.P., Status report on ECC penetration scaling research, 4:38815 (NUREG/CR—0651)
Collins, C.J., Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415—25)
Colton, J.D., Study of the mechanics of a transportation accident involving natural uranium concentrate. Final report, June 8, 1978—September 8, 1978, 4:38244 (NUREG/CR—0558)
Comley, G.C.W., Release of radioiodines from defective fuel in WSGHWR, 4:38644
Commerford, S.L., *See* Slatkin, D.N., 4:39692
Cone, B.W., Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL—2410-1(Rev.))
Conklin, J.C., *See* Ball, S.J., 4:38819
Conn, R.W., Tokamak reactors and structural materials, 4:40007 (UWFDM—288)
Connolly, P.L., *See* Cnops, A.M., 4:39819
Conover, W.J., Multiple-comparisons procedures. Informal report, 4:40037 (LA—7677-MS)
Conrad, J.M., Oil spills: the policy of prevention and the strategy of recovery, 4:38171 (PB—285931)
Constantinides, E., *See* Dalgarno, A., 4:39762
Conte, D., *See* Vitkovitsky, I.M., 4:39440
Conversi, M., *See* Read, A.L., 4:39821
Cook, B.A., Behavior of a failed fuel rod during film boiling operation, 4:38797 (CONF-790602—3)
Cook, C.W., Rehabilitation potential and practices of Colorado oil shale lands. Progress report, June 1, 1978—May 31, 1979, 4:38200 (COO—4018-3)
Cook, R.F., Measurement of pulverized fuel flow to burners using an acoustic technique, 4:38569 (N—78-28387)
Cool, R.L., Experimental physics. Annual report, July 1, 1978—March 1, 1979, 4:39814 (COO—2232A-78)
See Angelis, A.L.S., 4:39823, 4:39824
Cooney, C.S., *See* Bischoff, W.S., 4:38540, 4:38543
Cooper, J.W., *See* Kirk, T.B.W., 4:39825
Cooper, L., Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB—284041)
Cooper, M.D., Pion single charge exchange, 4:39885 (LA-UR—79-638)
See Bowman, J.D., 4:39818
Cooper, P., Passive solar house based on balanced direct gain heating and night ventilation cooling, 4:38424 (CONF-780337—P1, pp 4p, Book 2, Paper 4)
See Haggard, K., 4:38427
Coote, G.E., Nuclear energy from thorium. An introduction, 4:38723 (INS-R—230)
Copeland, R.L., *See* Adamski, J.L., 4:39381
Coquat, J.A., *See* Veneruso, A.F., 4:38527
Corbett, J.A., Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application, 4:38297 (WCAP—9344)
Corcoran, M.D., *See* Dris, M., 4:39826
Coremans-Bertrand, G., *See* Read, A.L., 4:39821
Corey, H.S., Microinterferometer transducer, 4:39510 (Y/DA—7109)
Cork, B., *See* Crabb, D.G., 4:39434
Cormell, L., *See* Dris, M., 4:39826
Cornacchia, M., *See* Allen, M.A., 4:39484
See Claus, J., 4:39471
See Close, E., 4:39483
Cornish, J., *See* Portch, R., 4:38951
Cornog, D.G., *See* Jonath, A.D., 4:39188
Correll, F.D., *See* Flynn, E.R., 4:39904
Corrigan, P.A., *See* Bucy, J.I., 4:39045
Corson, B.A., Energy efficient office building for the state of California, 4:38426 (CONF-780337—P1, pp 7p, Book 3, Paper 2)
Costogue, E.N., High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 1, 4:38378 (N—78-27530)
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2, 4:38379 (N—78-27531)
Cotter, J.E., Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976—July 1977, 4:38199 (PB—284027)
Cottrell, R.L.A., *See* Prescott, C.Y., 4:39870
Couchman, W.J.R., *See* Morris, W.H.D., 4:38998
Coulson, P.B., Quantitation by flow microfluorometry of total cellular DNA in Acanthamoeba, 4:39647
Courant, E.D., Enhanced resistive wall instability for off-centered beams, 4:39470 (BNL—25793)
See Claus, J., 4:39471
See Crabb, D.G., 4:39434
Coutant, C.C., Cooling Systems Program, 4:39621 (ORNL—5508, pp 17-23)
Coutts, H.J., Research on control technology for ice fog from mobile sources, 4:39079 (PB—285611)
Covert, D.S., *See* Charlson, R.J., 4:39536
Cowell, W.R., Discussion of session on reliability and warranty of numerical software, 4:40049 (DOE/TIC—10097)
Cox, A.N., *See* Davis, C.G., 4:39731
Crabb, D.G., Possibility of acceleration of polarized protons in the Brookhaven AGS, 4:39434 (BNL—25734)
Crabb, R., *See* Stoering, J.P., 4:39960
Craig, J.N., *See* Dytman, S.A., 4:39896
Craig, R.B., *See* Kroodsma, R.L., 4:38089
Crandall, C.C., *See* Bastin, J.J., 4:38230
Crandall, K.R., *See* Stokes, R.H., 4:39408
Crane, T.W., *See* Johnson, S.S., 4:38291
Crannell, C.J., Solar gamma rays above 8 MeV, 4:39751 (N—78-32031)
See Dolan, J.F., 4:39742
Crannell, H., *See* Crannell, C.J., 4:39751
Crawford, O.H., *See* Moak, C.D., 4:39170
Crawford, R.W., Computer automation of continuous-flow analyzers for trace constituents in water. Volume 4. Description of program segments. Part 1. TAAIN, 4:39203 (UCRL—52532(Vol.4)(Pt.1))
Crebbin, K.C., *See* Barale, J.J., 4:39457
Creswick, F.A., *See* Ellison, R.D., 4:38992
Crockett, S., *See* Lawwill, T., 4:39699
Croney, S.T., *See* Dyer, N.C., 4:38633
Cronkite, E.P., *See* Carsten, A.L., 4:39667
Crouse, R.S., *See* Harris, L.A., 4:38082
Crouthamel, C.E., Fuel performance improvement program. Quarterly progress report October—December 1978, 4:38624 (COO—4066-9)
Crowe, J.L., Lime/limestone scrubbing sludge characterization - Shawnee Test Facility. Final report March 1975—June 1976, 4:39352 (PB—284111)
Crummett, W.P., *See* Smith, H.G., 4:39102
Crumrine, K., Investigation of the environmental consequences of disposal of the lithium organic-electrolyte/SO_2 battery. Final report Sep 76-Jan 78, 4:39596 (AD-A—059512)
Cruz, L.R., Energy generating device, 4:39358
Csigi, K., *See* Almgren, D.W., 4:38402
Cukor, P.M., *See* Pigford, T.H., 4:38599
Cumalat, J.P., *See* Caldwell, D.O., 4:39817
Cummings, W.P., Natural gas dehydration with solid desiccant, 4:38176 (CONF-7611113—, pp 10p, Paper 3)
Cunningham, J.E., Selected advances in materials research, 4:39106 (CONF-790343—1)
Cunnington, G.R. Jr, *See* Brewer, G.D., 4:39017, 4:39018
Cuomo, J.J., Radiation energy converter, 4:38503
Curcio, J., *See* Bellows, A., 4:38101
Curnutte, B., *See* Annett, C.H., 4:39799
Currier, G., *See* Lawwill, T., 4:39699
Cutting, J.C., Influence of component redundancy on the availability of open cycle MHD power plants, 4:38947 (CONF-781009—, pp 129-160)
Cuzick, J., *See* Goldstein, I.F., 4:39696
Cverna, F.H., *See* Anderson, B.D., 4:39906
Cvanderna, A.W., *See* Prince, E.T., 4:39192

D

Dabhadkar, S.B., *See* Kotrappa, P., 4:38770
Dagan, S., *See* Gelfand, N., 4:39862
Dagazian, R.Y., *See* Freidberg, J.P., 4:39967
Dagenhart, W.K., *See* Stirling, W.L., 4:40011
Dahlquist, G., *See* Bjorstad, P., 4:40043
Daily, W.D., *See* Dyal, P., 4:39760
Dakin, J.T., Liquid-cooled turbine bucket with enhanced heat transfer performance, 4:38586

Dalgarno, A., Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 October 1976—31 December 1977, 4:39762 (AD-A—058684)
Dalinsky, Yu.L., *See* Burenkov, D.K., 4:38974
Daly, B.J., Scaling and constitutive relationships in downcomer modeling, 4:38813 (NUREG/CR—0561)
Dam, S.H., π^+ and π^- elastic scattering from ^{40}Ca at 65 MeV, 4:39903 (LA-UR—79-839)
Danby, G., *See* Allinger, J., 4:39436
Danielson, M.J., Construction and thermodynamic performance of an Ag—AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
Danilychev, V.A., *See* Basov, N.G., 4:39311
Dannevik, W., *See* Hull, L., 4:39559
Darbyshire, K., *See* Ward, R., 4:38105
Darkazalli, G., Description of the University of Texas at Arlington Solar Energy Research Facility photovoltaic/thermal residential system, 4:38397 (COO—4577-5)
Darley, P.J., Examination of radioactive particles in WSGHWR coolant circuits using scanning electron microscope autoradiography, 4:38645
Darr, M.M., *See* Pella, P.A., 4:39212
Darrow, K.A., *See* Dakin, J.T., 4:38586
Dasch, C.J., Vibrational energy transfer in selectively excited diatomic molecules, 4:39784 (LBL—8208)
Datz, S., *See* Moak, C.D., 4:39170
Daugeras, B.Y., *See* Gelfand, N., 4:39862
Davarashvili, O.I., *See* Gureev, D.M., 4:39309
Davenport, C.M., Computer automation of an electron-beam welder, 4:39097 (Y/DA—8239)
David, S.A., Electron-beam welding of thorium-doped iridium alloy sheets, 4:39092 (ORNL/TM—6711)
Davidoff, P., Preliminary economic evaluation of generic passive solar energy system/building applications, 4:38359 (CONF-780337—P1, pp 5p, Book 1, Paper 3)
Davids, C.N., *See* Holland, R.E., 4:39894
Davidson, K.A., Qualitative alterations in plasma esterases in BALB/c mice following the administration of diethylnitrosamine, 4:39648
Davidson, R.C., *See* Choe, J.Y., 4:39990
Davies, J., *See* Kirk, T.B.W., 4:39825
Davies, R.D., Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976—30 September 1977, 4:38888 (PB—286038)
Davis, B.W., Convection and thermal radiation analytical models applicable to a nuclear waste repository room, 4:38274 (UCID—18103)
Limitations to the use of two-dimensional thermal modeling of a nuclear waste repository, 4:38273 (UCID—18101)
Davis, C.G., Variable star research at Los Alamos, 4:39731 (LA-UR—78-3089)
Davis, D.A., Gas turbine, 4:39075
Davis, D.H., *See* Read, A.L., 4:39821
Davis, G.W., *See* Brewer, G.D., 4:39017, 4:39018
Davis, H.L., *See* Noonan, J.R., 4:39104
Davis, P.J., *See* Caldwell, D.O., 4:39817
Davis, R.C., *See* Stirling, W.L., 4:40011
Davis, T.J., *See* Dudder, G.B., 4:39167
Dawson, J., *See* Steinbruechel, C., 4:39098
Day, R.A., Baseline inspection of three transition joint life test articles, 4:38666 (GEFR—00414)
Dazen, J.R., *See* Bastin, J.J., 4:38228
De, J.N., *See* Huizenga, J.R., 4:39932
De Angelis, R.J., *See* Reucroft, P.J., 4:38056, 4:38057
De Brandt, C.W.M.V.A., *See* Blanchart, A.P.O., 4:38858
de Raedt, C., *See* Debrue, J., 4:38722
de Wys, J.N., *See* Shumaker, R.C., 4:38177
Debrue, J., Neutronic studies for the design of irradiation devices, 4:38722 (INIS-mf—4426, pp XI.1-12)
Decoster, R., *See* Armstrong, C.M., 4:39985
DeCoursin, D.G., *See* White, L.R., 4:38959
Dedushenko, K.B., *See* Borodulin, V.I., 4:39316
Defield, J.G., *See* Burns, R.E., 4:38263
Degnan, J.J., *See* Peruso, C.J., 4:39290
DeGrand, T., *See* Brodsky, S.J., 4:39842
DeGrand, T.A., Hadronic fragmentation initiated by pointlike probes, 4:39849
Degrey, S.P., *See* Leising, C.J., 4:39053
Deju, R.A., Basalt waste isolation program. Quarterly report, October 1—December 31, 1978, 4:38272 (RHO-BWI—79-100-1Q)
del Papa, C., Exclusive vector-meson production in muon-proton scattering, 4:39816
Delbrassine, A., Chemical interaction at the FBR cladding fuel interfaces, 4:38674 (INIS-mf—4426, pp VIII.1-15)
DelBueno, R.P., *See* Cutting, J.C., 4:38947
deLeon, P., Comparative analysis of high technology programs: the development and diffusion of the nuclear power reactor in six nations, 4:38896 (RAND-P—6115)
Delic, G., *See* Charlton, L.A., 4:39937
Demidov, B.A., Study of 200KA REB focussing depending on the Kalmar diode geometry, 4:39395 (CONF-771035—P2, pp 771-780)
Demina, A.M., Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135
Demirjian, A., *See* Cole, J., 4:38975
Demmie, P.N., Multidimensional analysis based on a two-fluid model of fluid flow in a component of the LOFT system during a loss of coolant experiment, 4:38795 (CONF-790423—3)
Demmitt, T.F., *See* Molton, P.M., 4:38319
Denholm, A.S., *See* Nablo, S.V., 4:39397
Denholm, D., *See* Bush, T.W., 4:38080
Denley, D., X-ray absorption fine structure above the Ti L edge, 4:39158
See Perfetti, P., 4:39954
Denning, R.S., Fusion power development issues. Final report, 4:38942 (PB—285566)
Dennis, B.R., *See* Dolan, J.F., 4:39742
Dennis, R., Model for coal fly ash filtration, 4:39550
der Mateosian, E., *See* Baktash, C., 4:39912
Derbenwick, G.F., Radiation-tolerant high-voltage CMOS/MNOS technology, 4:39338 (SAND—78-1523C)
Derevyankina, L.V., Effect of mineral fillers on the properties of plugging materials, 4:38150
Deshpande, N.G., Resolution of the eta′ → eta $\pi\pi$ puzzle, 4:39858 (DOE/ER/70004—218)
Despe, O.D., *See* McDowell, W.P., 4:39344
DeStaebler, H., *See* Prescott, C.Y., 4:39870
Destler, W.W., Linear beam collective ion acceleration for fusion applications, 4:39383 (CONF-771035—P2, pp 521-532)
Deuber, H., Determination of the physico-chemical species of radioiodine in the stack discharge of nuclear power plants, 4:38762 (KFK-EXT—30/78-1)
Deuster, G., Heat extraction from nuclear power plants, 4:38714 (INIS-mf—4376, pp 86-95)
Deutscher, S.B., *See* Harrar, J.E., 4:38545
Devereux, O.F., Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978—31 May 1979, 4:39091 (COO—2960-3)
DeVito, B., *See* Allinger, J., 4:39436
Devitt, T., Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April—December 1977, 4:38602 (PB—284045)
Devlin, P.J., *See* Van Arsdall, R.T., 4:38868
Diatchenko, N., *See* Brogan, T.R., 4:38973
Dibner, P.C., Response of a salt marsh to oil spill and cleanup: biotic and erosional effects in the Hackensack Meadowlands, New Jersey. Final report, May 1976—December 1977, 4:38167 (PB—285211)
Dickerhoof, D.W., *See* Gary, J.H., 4:38074
Dicks, J.B., Coal-fired MHD power generation: including balance of plant, 4:38950 (CONF-781009—, pp 471-482)
See Scott, M.H., 4:38984
See Wu, Y.C.L., 4:38956
Dicks, J.B. Jr., Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April—June 1977, 4:38957 (FE—1760-29)
Dickson, C.R., *See* Start, G.E., 4:38763
Dienst, W., *See* Karsten, G., 4:38676
Dietrich, D., *See* Alonso, J., 4:39795
Dietz, D.L., Relationships between noise and mb bias applied to seismic station site selection and performance evaluation. Technical report, 4:39525 (AD-A—058227)
DiGiacomo, N.J., Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
DiLiberto, S., *See* Read, A.L., 4:39821
Dinelli, G., Monitoring of thermal effluents: measurement techniques and selected field results, 4:39631
Dio, W.H., On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany, 4:38629
DiPippo, R., Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations, 4:38534 (COO—4051-41)
Geothermal power plants of Italy: A technical survey of existing installations, 4:38538 (COO—4051-34)
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO—4051-38)
Kakkonda Geothermal Power Plant, 4:38533 (COO—4051-40)
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO—4051-27)
Dirven, P., *See* Delbrassine, A., 4:38674
Dittner, P.F., *See* Moak, C.D., 4:39170
Dixon, J.M., *See* Shumaker, R.C., 4:38177
Dixon, R.L., Raise drill inner yoke bridge, 4:39280
Dodds, H.L. Jr., *See* Hoffman, T.J., 4:39781
Doganoglu, Y., Removal of fine particulates from gases in fluidized beds, 4:39350
Doggett, W.O., *See* Pasour, J.A., 4:39390

Dolan, J.F., High energy x-ray spectra of Cygnus XR-1 observed from OSO-8, 4:39742 (N—78-32017)
Doll, J.D., *See* Whitten, J.L., 4:39229
Dols, C.G., *See* Green, M.I., 4:39458
Domanus, H.M., *See* Sha, W.T., 4:38685
Dombrowski, O., *See* Koppers, M., 4:38107
Donaldson, A.B., *See* Bader, B.E., 4:38145
Donangelo, R., *See* Oliveira, L.F., 4:39935
Donnelly, J.A., *See* Moosavi, H., 4:39650
Donnelly, M.G., *See* Caldwell, D.O., 4:39817
Donovan, J.M., *See* Molton, P.M., 4:38319
Dooley, D., Chemical reduction of refractory oxides by atomic hydrogen, 4:39254 (LBL—8548)
Doolittle, R.D., *See* Carey, W.M., 4:38698
Dorfan, D., *See* del Papa, C., 4:39816
Dorfan, J., *See* Heile, F.B., 4:39846
Doss, K.G.R., *See* Dytman, S.A., 4:39896
Doucet, H.J., *See* Buzzi, J.M., 4:39332
Douglas, S.B., *See* Wallhagen, R.E., 4:38104
Douglass, D.L., Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID—29304)
Dowdy, M., Automotive technology status and projections. Volume 1. Executive summary, 4:39054 (N—78-31428)
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N—78-31429)
Downing, R.G., Characterization of solar cells for space applications. Volume 2: electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature, 4:38387 (N—78-30662)
Downing, R.H., *See* Gamble, H.B., 4:38759
Dragt, A.J., Method of transfer maps for linear and nonlinear beam elements, 4:39402 (LA-UR—79-699)
Draper, B.L., Extension of high temperature electronics, 4:39340 (SAND—79-0388C)
Dris, M., π^+ structure information from a jet experiment, 4:39826
Driscoll, M.J., MIT LMFBR blanket research project. Quarterly progress report, October 1—December 31, 1978, 4:38665 (COO—2250-35)
Drobot, A., *See* Adler, R., 4:39382
Drobot, A.T., *See* Granatstein, V.L., 4:39333
See Sprangle, P., 4:39336
Drolet, T.S., Development of the CANDU heat transport purification system design philosophy, 4:38646
Duba, A.G., *See* Lytle, R.J., 4:39709
Dubovskii, B.G., *See* Mitel'man, M.G., 4:39491
Duda, J.R., *See* Lavin, M.L., 4:38097
Dudas, A.J., *See* Lebacqz, J.V., 4:39462
Dudder, G.B., Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL—2805)
Dudley, V.E., Performance testing of the del concentrating solar collector, 4:38501 (SAND—79-0515)
Summary report. Concentrating solar collector test results Collector Module Test Facility (CMTF), January—December 1978, 4:38497 (SAND—78-0977)
Dudziak, D.J., Transport and reactor theory. Progress report, October 1—December 31, 1978, 4:38724 (LA—7704-PR)
Duff, M.F., Feasibility of a Mound-designed transportable calorimeter, 4:38292 (MLM—2603)
Duffield, C., Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper, 4:38358 (PB—285129)
Duggan, J.L., *See* Mehta, R., 4:39779
Dukler, A.E., Two phase interactions in counter-current flow: studies of the flooding mechanism. Annual report, November 1975—October 1977, 4:38814 (NUREG/CR—0617)
Duncan, D.A., Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). First quarter report, April 1—June 30, 1978, 4:38075 (FE—2307-38)
Duncan, I.P., Testing and simulation of passive solar systems, 4:38460 (CONF-780337—P3, pp 7p, Book 3, Paper 1)
Duncan, L.M., *See* Gordon, W.E., 4:38403
Dunlap, J.L., *See* Murakami, M., 4:39970
Dunlap, R.W., Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE—2496-12)
Dunlop, J.D., *See* van Ommering, G., 4:38986
Dunn, E.D., *See* van Dyck, O.B., 4:39377
Dunn, W.E., *See* Policastro, A.J., 4:39625, 4:39626
Duong-van, M., *See* del Papa, C., 4:39816
Durand, R.E., *See* Spalaris, C.N., 4:38667
Durbin, P.W., *See* Rowland, R.E., 4:39682
Durran, D.R., *See* Liu, M., 4:39568
Dutta, S., Simple probe for fluidized bed measurements0, 4:39808
Duvall, T.L. Jr, A study of large-scale solar magnetic and velocity fields, 4:39745 (N—78-29027)
See Svalgaard, L., 4:39747
Duym, A., Energy conserving fume hood, 4:39035
Dyal, P., Crustal evolution inferred from apollo magnetic measurements, 4:39760 (N—78-32029)
Dyer, N.C., Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR—0755)
Dyer, P., Incomplete momentum transfer in peripheral heavy-ion collisions at 20 MeV/nucleon, 4:39925
Dylla, H.F., Observations of changes in residual gas and surface composition with discharge cleaning in PLT, 4:40024
See Rossnagel, S.M., 4:39152
See Wampler, W.R., 4:40006
Dytman, S.A., Low energy π^+ scattering from light nuclei, 4:39896

E

Eads, B.G., Development of in-vessel reflood instrumentation at ORNL, 4:38794 (CONF-790340—1)
Earley, R.F., Macroeconomic and sector implications of installing 2.2 million residential solar units, 4:38360 (DOE/EIA—0102/51)
Eason, E.D., Solution of non-linear differential equations by discrete least squares, 4:40045
Eccleston, D.B., *See* Allsup, J.R., 4:39089
Eccleston, G.W., *See* Johnson, S.S., 4:38291
Eckels, R., *See* Cutting, J.C., 4:38947
Edalat, M., Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants, 4:38706 (IAEA—206, pp 47-72)
Edelman, R.B., *See* Blazowski, W.S., 4:38592
Edelmann, M., Noise and DC balanced outlet temperature signals for monitoring coolant flow in LMFBR fuel elements, 4:38692
Edelsack, E.A., Superconducting devices and materials. A literature survey issued quarterly, October—December 1978, 4:39955 (NBS—78-04)
Edens, T.C., Resources, residuals and irreversible land conversions: prototype management instruments, 4:38877 (PB—283968)
Edeskuty, F.J., DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977—September 30, 1978, 4:38622 (LA—7707-PR)
Edge, R.D., *See* Dam, S.H., 4:39903
Edmiston, W., *See* Dowdy, M., 4:39054, 4:39063
Edmonds, P.H., *See* Murakami, M., 4:39970
Edney, E.B., *See* Franco, P.J., 4:39595
Edwards, D. Jr., Heat of vaporization spectrometer, 4:39234
Ion and electron desorption of neutral molecules from stainless steel (304), 4:40025
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL—25733)
See Aggus, J., 4:39437
Edwards, M.S., Economics of gasoline production from underground coal gasification via Mobil-M process, 4:38047 (CONF-790405—12)
Efimkov, V.F., *See* Grasyuk, A.Z., 4:39310
Efimov, E.N., *See* Abramyan, E.A., 4:39393
Efros, V.L., *See* Luzyanin, G.S., 4:38154
Efthimion, P.C., *See* Bitter, M., 4:39973
See Schlesinger, S.P., 4:39334
Eggert, G.J., *See* Lee, P.L., 4:39497
Egleman, E., *See* Weng, W.T., 4:39429
Egler, W., Basic concept of a prediction model for the cooling tower plume, 4:39591
Egloff, R.M., *See* Caldwell, D.O., 4:39817
Ehsani, M., Square function analysis of the Inductor-Converter Bridge, 4:39268 (ANL/FPP/TM—118)
Eichler, D., Neutron beams in active galactic nuclei, 4:39754
Eichler, R.A., *See* Bowman, J.D., 4:39818
Einhorn, M.B., Phase transitions in the Abelian Higgs model, 4:39840
Eisen, Y., *See* Stokstad, R.G., 4:39911
Eisenberger, P., *See* Hastings, J.B., 4:39463
Eisenhaure, D., A limited investigation into regenerative braking and energy storage for mass transit systems. Final report March-October 1977, 4:38834 (PB—284611)
Eisenhower, E.H., American national standard N433.1; safe design and use of self-contained, dry source storage gamma irradiators (Category I). Final report, 4:38303 (PB—285117)
Eisenstein, R.A., *See* Dytman, S.A., 4:39896
Eisner, A.M., *See* Caldwell, D.O., 4:39817
Eissenberg, D.M., Low-Temperature Thermal Energy Storage Program. Progress report, October 1978—March 1979, 4:38838 (ORNL/TM—6936)
See Brunton, G.D., 4:38837
Ekberg, E.L., *See* Grisham, D.L., 4:39451
Ekin, J.W., *See* Edelsack, E.A., 4:39955
El-Hawary, M.E., Optimum hydrothermal electric energy system scheduling: challenges and opportunities in research and development in Canada, 4:38572

El-Roumi, B., Desalination projects in the Kingdom of Saudi Arabia, 4:38707 (IAEA—206, pp 43-46)
Elbel, K., *See* Karsten, G., 4:38676
Eldridge, J.S., Planning for unplanned releases, 4:38761
Eliason, J.F., Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
Elle, D.R., USERDA effluent data collection and reporting program, 4:39583
Ellingson, A.C., Proposed standard for ES and H assurance programs, 4:39704 (SAND—79-0240)
Ellis, M.J., *See* Harris, G.S., 4:38913
Ellis, W.P., *See* Taylor, T.N., 4:39154
Ellison, E.G., Strain range partitioning in cyclic creep of a 1Cr—Mo—V steel, 4:39141
Ellison, R.D., Heat pump modeling: a progress report, 4:38992 (CONF-790446—4)
Elsaesser, H.W., Stratospheric H_2O, 4:39533 (UCRL—82542)
Elsaesser, F.L., Detector and process for determining discontinuity of flow in a gas turbine drive, 4:38588
Elston, S.B., Many-electron aspects of molecular promotion in ion-atom collisions: Production of core-excited states of Li in Li^+-He collisions, 4:39798
Elwyn, A.J., *See* Holland, R.E., 4:39894
Emani, M., Status of desalination projects in Iran, 4:38708 (IAEA—206, pp 33-41)
Emerson, L.C., Surface impurity studies in the ISX-A tokamak, 4:40027
See Clausing, R.E., 4:40022
Emerson, R.E., *See* Colton, J.D., 4:38244
Emery, A.F., Comparison of some characteristics of finite element and finite difference calculations of transient thermal problems, 4:39326 (SAND—78-8047)
Emmerson, H.R., *See* Bechtold, I.C., 4:38317
Emmett, R.W., *See* Bokharee, S.A., 4:39444
Engebretsen, A.R., Economic comparison of five hydroelectric projects in Idaho, 4:38345
Engelke, R., Diatomic-molecule vibrational potentials. II. New representationsa), 4:39785
Englesson, G.A., *See* Hu, M.C., 4:38575
Ensslin, N., Inelastic electron scattering from ^{14}N at 180°, 4:39890
Entessari, J., *See* Edalat, M., 4:38706
Entsminger, M.A., *See* Seila, A.F., 4:38938
Epperly, W.R., EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966—1975), interim report, 4:38077 (FE—2893-16)
Epstein, J., *See* Laska, R., 4:39527
See Lightner, R.G., 4:38952
Epstein, R.A., Synthesis and characterization of the mixed-metal alkylidyne clusters RcFeCo2(CO)9h (r = CH3, C2H5, C6H5). Interim technical report, 4:39216 (AD-A—058229)
Erb, K.A., *See* Phillips, R.L., 4:39886
Erickson, M.D., *See* Pellizzari, E.D., 4:39202
Ermakov, V.V., Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans—11473)
Ernst, D.J., *See* Anderson, B.D., 4:39906
Ernst, G., Cooling towers, design and plume behavior, 4:38578
See Egler, W., 4:39591
Erwin, A.R., *See* Dris, M., 4:39826
Espana, C., *See* Anderson, D.G., 4:39724
Essling, M., *See* Rundo, J., 4:39683
Essling, M.A., Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se—selenomethionine, 4:39689 (ANL—78-65(Pt.2), pp 167-170)
See Toohey, R.E., 4:39684
Esvelt, L.A., *See* Thompson, H.W., 4:39043
Etlicher, B., *See* Buzzi, J.M., 4:39332
Euringer, H., *See* Krug, W., 4:38677
Evans, J.V., *See* Nicholson, F.D., 4:38628
Evans, R.D., Reduction of patient dose delivered by CHR diagnostic x-ray examinations, 4:39661 (ANL—78-65(Pt.2), pp 70-79)
Evensizer, J., *See* Leeds, M.W., 4:38528
Everhart, D.L., NURE plans and progress, 4:38221 (GJO—108(78), pp 73-98)
Eviatar, A., *See* Goldstein, M.L., 4:39758
Evseev, G.S., Unit for automatically constructing curves of the fall in intensity of seismic signals, 4:39718
Evseev, V.S., *See* Chikovani, V.V., 4:39267
Eyman, L.D., *See* Ward, D.S., 4:38260
Ezoe, M., *See* Asano, M., 4:39060

F

Faber, J. Jr., Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341—2)
Faddick, R.R., *See* Link, J.M., 4:38186
Faehl, R.J., *See* Shanahan, W.R., 4:39400
Fagg, L.W., *See* Ensslin, N., 4:39890
Fairman, W.D., *See* Rundo, J., 4:39683
Faizulaev, V.N., *See* Konyukhov, V.K., 4:39306
Fake, J.M., *See* Rozenman, T., 4:38576
Falicov, L.M., *See* Balseiro, C.A., 4:39957
Fanchenko, S.D., *See* Demidov, B.A., 4:39395
Farmer, R., Motor gasoline prices through 1980 under continued DOE price controls, 4:38916 (DOE/EIA—0102/39)
Farmer, R.C., *See* Matula, R.A., 4:38174
Farnham, J.E., *See* Larsen, R.P., 4:39688
Farnsworth, A.V. Jr., Self-similar power-driven expansion into vacuum, 4:40017
See Johnson, D.J., 4:39780
Fasang, P.P., *See* Mulder, M.C., 4:38617
Fatkullin, A.Kh., *See* Muslimov, R.Kh., 4:38198
Favorskii, A.P., *See* Goloviznin, V.M., 4:39809
Fearing, H.W., *See* Nefkens, B.M.K., 4:39827
Federici, L., *See* Read, A.L., 4:39821
Fefilov, B.V., *See* Flerov, G.N., 4:39919
Feibelman, P.J., *See* Knotek, M.L., 4:39225
Feik, K., *See* Moravek, J., 4:38737
Feldman, G.J., *See* Heile, F.B., 4:39846
Feldman, W.C., *See* Gosling, J.T., 4:39738
Feldmann, H.F., Conversion of forest residues to a methane-rich gas, 4:38322
Felgenhauer, D.L., WWP view, 4:38341
Feller, D.F., Systematic determination of extended atomic orbital basis sets and application to molecular SCF and MCSCF calculations, 4:39801 (IS-T—852)
Fellers, C.L., *See* Duff, M.F., 4:38292
Feltman, A., *See* Crabb, D.G., 4:39434
Fenimore, E.E., Coded aperture imaging with uniformly redundant arrays, 4:39490
Ferrer, M.L., *See* Read, A.L., 4:39821
Ferris, G., *See* Mason, B., 4:38367
Feynman, R.P., Expectations for ultra-high energy interactions, 4:39855 (LBL—7574, pp 15-30)
Fickett, F.R., *See* Edelsack, E.A., 4:39955
Fickett, W., M-3 Series on Detonation Science. II. One-dimensional flow, 4:39516 (LA—7817-MS(Vol.2))
Fiege, H., *See* Gaertner, M., 4:38802
Field, M.B., Evaluation of glass resin coatings for solar cell applications. Final report, 4:38381 (N—78-27540)
Fielder, W.L., Solubility, stability, and electrochemical studies of sulfur—sulfide solutions in organic solvents, 4:38849 (N—78-28624)
Fields, S.R., Dynamic analysis to establish normal shock and vibration of radioactive material shippng packages. Quarterly progress report, July—September 1978, 4:39277 (NUREG/CR—0589)
Finegold, J.G., *See* Leising, C.J., 4:39053
Finney, A.J.T., Energy analysis: a Tasmanian application, 4:38862 (PB—283949)
Finnigan, J.J., *See* Sheih, C.M., 4:39511
Fischenko, P.A., *See* Kazanovich, B.B., 4:38577
Fischer, S.K., *See* Ellison, R.D., 4:38992
Fischer, W., Electrochemical storage cell, 4:38851
Fischler, W., Quark confinement in unusual environments, 4:39875
Fisher, E.S., *See* Smith, H.G., 4:39102
Fisher, M.E., *See* Baker, G.A. Jr., 4:39947
Fisher, R.M., Fundamental factors in catalyzed carbon—gas reactions, 4:38064 (LBL—8975, pp 37.-39.)
Fisher, R.W., *See* Wheelock, T.D., 4:38044
Fitoussi, L., General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities, 4:38288
Flanigan, L.J., *See* Collier, R.P., 4:38815
Flannery, M.R., *See* McCann, K.J., 4:39797
Flatte, S.M., *See* del Papa, C., 4:39816
Fleming, E.S., *See* Waibel, R.T., 4:38123
Flerov, G.N., Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr—678)
Flicker, H., *See* Begley, R.F., 4:39237
Flotard, R.D., *See* Harrison, W., 4:38161
Floyd, A.L., Science advisor report to Burbank City Council, 1975—1976, 4:39051 (PB—283860)
Flynn, E.R., Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
See Loehoeiden, G., 4:39913
Foelsche, H., *See* Weng, W.T., 4:39469
Fogdall, L.B., Simulation of space radiation effects on polyimide film materials for high temperature applications. Final report, 4:39197 (N—78-28604)
Folomkin, I.P., *See* Burakov, V.S., 4:39975
Fonash, S.J., Basic mechanisms study for MIS solar cell structures on GaAs. Final report, 4:38383 (N—78-28601)
Ford, D., *See* Harrison, W., 4:38161
Ford, J.L.C., *See* Maguire, C.F., 4:39902
Ford, R.D., *See* Vitkovitsky, I.M., 4:39440
Forrest, L., Analysis of timing and carburetion calibrations. Final report, 4:39056 (PB—283953)
Forrest, W.J., *See* Gull, G.E., 4:39733
Foss, J.E., *See* Mulchi, C.L., 4:38593, 4:38594, 4:38595, 4:38596, 4:38597
Foss, M.H., Septum magnet coil design principles, 4:39445 (DOE/TIC—10045)
Fouarge, L., *See* Debrue, J., 4:38722
Fowkes, W.R., *See* Lebacqz, J.V., 4:39462
Fowler, C.F., *See* Kok, B., 4:39555
Fowler, T.K., *See* Baldwin, D.E., 4:40002
Fox, J.D., *See* Lumpkin, A.H., 4:39891
Fox, R.L., *See* Bader, B.E., 4:38145
Frame, E.A., High sulfur fuel effects in a two-cycle high speed army diesel engine. Interim report Oct 76-May 78, 4:39072 (AD-A—059534)

Francis, B.A., Chalk point cooling tower project: effects of simulated saline cooling tower drift on woody species. Master's thesis, 4:38598 (PB—284214)
Franco, P.J., Distribution and abundance of soil arthropods in the northern Mojave desert, 4:39595 (UCLA—12-1190)
Frank, J.S., Low energy PI super plus / sub p/ elastic scattering, 4:39832 (LA-UR—79-893)
Frankel, F., *See* Bland, R., 4:38172
Franklin, H., *See* Bush, T.W., 4:38080
Franta, G.E., Rocky Mountain greenrooms, 4:38449 (CONF-780337—P2, pp 2p, Book 3, Paper 5)
Franzen, L.F., Control of liquid radioactive effluents from nuclear power plants in the Federal Republic of Germany, 4:38764
Fraser, G., *See* Luykx, F., 4:38771
Fraser, J.K., *See* Ziegler, D.L., 4:38257
Frederikse, H.P.R., Telegin, G.P., *See* Schneider, S.J., 4:39165
Freed, J., *See* Crumrine, K., 4:39596
Freed, J.H., ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions, 4:39224 (LBL—8975, pp 29.-30.)
Freed, K.F., *See* Morse, M.D., 4:39768, 4:39769
Freeman, R., *See* Holmes-siedle, A., 4:39503
Freidberg, J.P., Equilibria of diffuse high beta stellarators, 4:39967
Freier, P.S., *See* Scarlett, W.R., 4:39729
Frerking, M., Hull residence: a passive solar hybrid system, 4:38432 (CONF-780337—P2, pp 5p, Book 2, Paper 1)
Frick, T.M., Simplified design methods for nonlinear dynamic mechanical systems, 4:39958 (CONF-790608—1)
Fricke, L., *See* Graf, G.L., 4:38194
Fricker, H.W., *See* Huddle, R.A.U., 4:38719
Friedberg, E.C., *See* Simmons, R.R., 4:39641
Friedman, H.A., *See* Toth, L.M., 4:39253
Friedman, L.R., Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast, 4:39659 (UR—3490-1568)
Friedman, M., New collective particle accelerator, 4:39384 (CONF-771035—P2, pp 533-540)
See Lockner, T., 4:39388
Friello, D.A., *See* Chakrabarty, A.M., 4:39644
Fritz, I.J., *See* Yarberry, V.R., 4:39178
Fritzsche, G., Development of methods to measure the oil consumption of piston engines by means of radionuclide techniques, 4:38304 (KFK—2463)
Frost, C.R., Chemical control and design considerations for CANDU-PHW steam generators, 4:38647
Frost, K.J., *See* Dolan, J.F., 4:39742
Frutiger, W.A., *See* Nablo, S.V., 4:39397
Fu, C.Y., *See* Hetrick, D.M., 4:39900
Fuh, G.F., Design analysis of annular tunnels for superconductive energy storage using the finite element method, 4:38832
Fujishiro, T., *See* Asano, M., 4:39060
Fujita, M., Preliminary experiment on crack propagation in zircaloy-cladding. Failure behavior of zircaloy-cladding, (1), 4:38807 (JAERI-M—7453)
Fukuda, K., *See* Sugimura, H., 4:38079
Fulford, R.S., *See* Joseph, C., 4:38144
Fuller, E.L., Interactions of gases with coal: structural inferences, 4:38081 (CONF-790415—26)
Fulrath, R.M., *See* Nagesh, V.K., 4:39342
Funabashi, M., *See* Araki, T., 4:39353
Fung, S., Detectors; relation of detectors to proton-anti proton machines, 4:39455 (LBL—7574, pp 112-120)
Furet, J., Neutronic control instrumentation of protection systems, 4:38733 (CEA-CONF—3997)
Furst, G.B., Review of optimization and economic evaluation of potential tidal power developments in the Bay of Fundy, 4:38555

G

Gabdrakhmanov, A.G., Pumping an aqueous solution of polyacrylamide, 4:38156
Gabel, C.W., *See* Kostuk, R.K., 4:39649
Gabriel, T.A., *See* Alsmiller, R.G. Jr., 4:39360
Gad-el-Hak, M., *See* Lin, J., 4:38162
Gaertner, M., Technical aspects for PWR safety experiments with single rods and rod bundles in BR2 Mol, 4:38802 (INIS-mf—4426, pp V.1-11)
Gaffey, C.T., Changes in the electrocardiograms of rats and dogs exposed to dc magnetic fields, 4:39702 (LBL—9085)
Galayda, J., *See* Krinsky, S., 4:39468
Gale, R.J., Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces, 4:39772 (LBL—7687)
Gamble, H.B., Effects of nuclear power plants on community growth and residential property values. Final report, September 30, 1977—November 15, 1978, 4:38759 (NUREG/CR—0454)
Gamburtsev, A.G., *See* Berzon, I.S., 4:39713
Gammage, R.B., Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415—31)
Gammel, G., *See* Adler, R., 4:39382
Gammel, G.M., Bunched beam neutralization, 4:39380 (BNL—25788)
Gandolfo, J.M., *See* Baugnet, J.M., 4:38783
Ganefel'd, R.V., *See* Bystry, A.I., 4:38979
Ganic, E.N., Comparative study of working fluids for OTEC power plants, 4:38411 (ANL/OTEC-TM—1)
Ganiev, V.A., Use of simultaneous grouping of sources and receivers of elastic oscillations in seismic surveys, 4:39717
Gans, I., Experience in monitoring radioactive liquid effluents from nuclear facilities in the Federal Republic of Germany, 4:38765
Gaponov, I.M., Development of a technique for measurement of electrical conductivity of plasma in MHD generator channels, 4:38964 (CONF-781009—, pp 715-728)
Garber, R.W., *See* Michael, P., 4:39540
Garbutt, D.A., *See* Read, A.L., 4:39821
Garcia de Viedma, L., Activities of the Nuclear Energy Agency Computer program library, 4:38282
Garcilazo, H., Effect of short-range correlations in the second order pion-carbon optical potential, 4:39889
Gardner, W.L., *See* Stirling, W.L., 4:40011
Garnett, J.E., *See* Ziegler, D.L., 4:38257
Garrett, A.A., *See* Larson, D.E., 4:38255
Garwin, E.L., *See* Prescott, C.Y., 4:39870
Gary, J.H., Clean solid and liquid fuels from coal. Quarterly progress report, April—June 1978, 4:38074 (FE—2047-9)
Gasper, E., *See* Boersma, L., 4:38318
Gaudet, A.D., *See* Almgren, D.W., 4:38402
Gauster, W.B., Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND—79-0636C)
See Wampler, W.R., 4:39094
Gavin, A.P., *See* Carey, W.M., 4:38698
Gavrilova, L.I., *See* Mishin, G.T., 4:38204
Gay, T.J., Temperature dependence of alignment production in He I by beam-foil excitation, 4:39778
Gaysert, G., Elastic mounting for a catalytic converter in an internal combustion engine, 4:39082
Gaziyants, A.P., Operational features of boreholes equipped with heat-insulated throwout lines with accessory thermal minerals, 4:38173
Gehrs, C.W., Synthetic Fuels Program, 4:38090 (ORNL—5508, pp 36-48)
Gelbke, C.K., Energy dependence of peripheral reactions induced by heavy ions, 4:39915
See Dyer, P., 4:39925
Geldner, P., *See* Zimmermann, C., 4:39630
Gelfand, N., Amplitude analysis of the reaction $\pi^+ p \rightarrow rho^0 \Delta^{++}$ at 3.75 GeV/c, 4:39862
Gemmell, M.A., *See* Lloyd, E.L., 4:39675, 4:39685, 4:39686
Gentile, S., *See* Read, A.L., 4:39821
Gentry, W.R., Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978—April 30, 1979, 4:39790 (COO—2640-10)
Geoffroy, G.L., *See* Epstein, R.A., 4:39216
Gerasimov, N.N., *See* Bulanov, N.A., 4:38136
Gerstein, B.C., Heterogeneous catalysis and surface chemistry, 4:39231 (LBL—8975, pp 73.-74.)
Gerstle, R., *See* Devitt, T., 4:38602
Gerth, H.L., *See* Barkman, W.E., 4:39263
Gibbs, L., *See* Devitt, T., 4:38602
Gibbs, R.E., *See* Burnell, L.K., 4:39356
Gibson, B.F., Kaon interactions with very light nuclei, 4:39831 (LA-UR—79-653)
Gidaspow, D., Separation of particles from coal-derived liquids via surface charge properties. Quarterly progress report, September 15, 1977—December 15, 1977, 4:38072 (COO—4324-T1)
Giese, R., Cost-allocation model for assessing the impact of energy-storage technologies upon electric utilities, 4:38897 (CONF-781213—6)
Giese, R.F., *See* Asbury, J.G., 4:39003
Gieseke, J.A., Fission product transport analysis. Quarterly progress report, January 1—March 31, 1978, 4:38816 (NUREG/CR—0697)
Fission product transport analysis. Quarterly progress report, April 1—June 30, 1978, 4:38817 (NUREG/CR—0698)
Gilchrist, M.C., *See* Olson, R.E., 4:38232
Gilgenbach, R.M., *See* Marshall, T.C., 4:39335
Gilkey, A.D., Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB—285628)
Gill, E., *See* Weng, W.T., 4:39429
Gill, G.H., Method for using geothermal energy, 4:38551
Gillani, N.V., *See* White, W.H., 4:39575
Gillies, J., Thermal vacuum life test of an MSDS solar array drive (MSDS No. 2). First 2 years of operation, 4:38382 (N—78-28475)
Gilmore, C., Overview of existing Federal programs in low-head hydro, 4:38339
Girardi, F., Status report on research programmes of the Commission of European Communities related to risk

evaluation of geological disposal of radioactive waste, 4:38277
Giuffre, M.S., *See* Byrne, R.J., 4:38267
Gladd, N.T., Finite beta effects on the drift-cyclotron instability, 4:39993
See Huba, J.D., 4:39766
Gladwell, J.S., Low-head hydro: an examination of an alternative energy source, 4:38325
Glagola, B.G., *See* Moyle, R.A., 4:39895
Glancy, W.P., Run-around type energy recovery system, 4:39001
Glaros, S.S., Shiva and Argus target diagnostics vacuum systems, 4:40021
Glass, N.R., Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB—285440)
Glendenning, N.K., *See* Charlton, L.A., 4:39937
Glenn, J.W., *See* Allinger, J., 4:39436
Glenn, R.G., Multiple-piece ceramic turbine blade, 4:38587
Glover, T.L., Wood burning stove with forced air heating, 4:38994
Gluekler, E.L., *See* Yang, H.K., 4:38800
Gnadt, P.A., Fuel pin simulators for sodium boiling tests in the THORS facility, 4:38687 (ORNL/TM—6688)
Goddard, H.C., Planning water supply: cost-rate differentials and plumbing permits. Final report, 4:39052 (PB—285656)
Goddard, M.C., ΛK and ΣK systems observed in π^+ interactions at 10.3 GeV/c, 4:39864
Goddard III, W.A., *See* Upton, T.H., 4:39151
Godel, J.B., *See* Schuchman, J.C., 4:39330
Godfrey, B.B., *See* Kwan, T., 4:39289
See Shanahan, W.R., 4:39400
Goff, R.M., *See* Brogan, T.R., 4:38973
Gokhstein, Ya.P., Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009—, pp 635-687)
Golay, M.W., *See* Todreas, N.E., 4:38663, 4:38664
Golden, J.A., Investigation of group IV-A metal vapor generation and flux behavior. Final report, 4:39283 (AD-A—058306)
See Zavitsanos, P.D., 4:38045
Golden, J.O., *See* Gary, J.H., 4:38074
Goldgraben, G.R., An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB—285227)
Goldhaber, G., *See* Heile, F.B., 4:39846
Goldman, A., Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977—15 April 1978, 4:39547 (N—78-27687)
Goldman, M., *See* Bitter, M., 4:39973
Goldsmith, K., Small nuclear reactors for desalination, 4:38709 (IAEA—206, pp 95-108)
Goldstein, D.B., Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings, 4:38470 (LBL—7811)
Goldstein, I.F., Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO—2874-46)
Goldstein, L.H., Controllability/observability analysis of digital circuits, 4:39339 (SAND—78-1859C)
Goldstein, M.L., An emission mechanism for the Io-independent Jovian decameter radiation, 4:39758 (N—78-31027)
Goldwasser, E., *See* Eliason, J.F., 4:39639
See Van Zant, G., 4:39640
Gollon, P.J., *See* Dris, M., 4:39826
Goloviznin, V.M., Variational approach to the construction of difference systems for hydrodynamic equations in spherical coordinates, 4:39809 (UCRL-Trans—11468)
Gomez, M.F., *See* Dudziak, D.J., 4:38724
Gomez del Campo, J., *See* Maguire, C.F., 4:39902
Gomzikov, V.K., Evaluation of final petroleum yield of Ural-Povolzh'e deposits in the early stages of their study, 4:38155
Goncharov, I.G., *See* Borodulin, V.I., 4:39316
Gonidec, A., *See* Prescott, C.Y., 4:39870
Goodale, D.B., *See* Kroeger, E., 4:38985
Goodall, I.W., Structures subjected to severe loading conditions, 4:38734
Goodman, A.M., Material data for high temperature design, 4:39142
Goodman, J., *See* Olson, R.E., 4:38232
See Woodsum, H.C., 4:38234
Goodman, M., *See* Kirk, T.B.W., 4:39825
Gopal, R., Experience with diagnostic instrumentation in nuclear power plants, 4:38636
Goranson, C., Evaluation of Coso Geothermal Exploratory Hole No. 1 (CGEH-1) Coso Hot Springs: KGRA, China Lake, CA, 4:38526 (LBL—8675)
Goranson, C.B., *See* Narasimhan, T.N., 4:38546
Gordon, H.A., *See* Goddard, M.C., 4:39864
Gordon, N.R., Heliostat reflective surface substrate characterization, 4:38408 (PNL—2810)
Gordon, R.L., Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report, 4:38129 (PB—285944)
See Lessor, D.L., 4:39514
Gordon, W.E., Ionosphere/microwave beam interaction study. Final report, 4:38403 (N—78-30475)
Gorman, D.J., *See* Pettigrew, M.J., 4:38731
Gorodnov, V.P., *See* Intyashin, A.D., 4:38147
Gorshkov, G.F., *See* Luzyanin, G.S., 4:38154
Gorshunov, N.M., *See* Bashkin, A.S., 4:39317
Gosling, J.T., Ion acceleration at the earth's bow shock: a review of observations in the upstream region, 4:39738 (LA-UR—79-309)
Gott, K.E., Residual stresses in a weldment of pressure vessel steel, 4:38746
Gould, H., *See* Alonso, J., 4:39795
Gould, R.K., Development of a model and computer code to describe solar grade silicon production processes. Fourth quarterly report, July 1—September 30, 1978, 4:38398 (DOE/JPL/954862—4)
Goulding, F.S., *See* Jaklevic, J.M., 4:39545
Grabner, A., Decomposition of noise signals composed of many similar components, 4:38637
Grachev, A.P., *See* Borodulin, V.I., 4:39316
Graf, G.L., Oil shale in situ research and development. Quarterly report No. 1, August 1—October 31, 1977, 4:38193 (TID—28955)
Oil shale in situ research and development. Quarterly report No. 3, February 1—April 30, 1978, 4:38194 (TID—28958)
Gram, P.A.M., *See* Frank, J.S., 4:39832
Granatstein, V.L., Coherent microwave scattering from intense relativistic electron beams: a powerful, tunable source of millimeter and submillimeter radiation, 4:39333 (CONF-771035—P2, pp 675-689)
See Sprangle, P., 4:39336
Grand, P., *See* Steinberg, M., 4:38225
Granoff, B., Mineral matter effects and catalyst characterization in coal liquefaction. Annual report, October 1977—September 1978, 4:38078 (SAND—79-0505)
Granovsky, E.A., *See* Maslennikov, V.M., 4:38960
Grassl, P., *See* Becker, D.E., 4:38742
Grasyuk, A.Z., Influence of the degree of polarization on the gain in stimulated Raman scattering, 4:39310
Grebenyuk, V.N., *See* Grasyuk, A.Z., 4:39310
Green, B., Implementation of state solar incentives: research, development, and demonstration programs, 4:38353 (SERI/TR—51-161)
Green, M.I., Precision magnetic measurements by the floating wire analog technique, 4:39458 (LBL—8818)
Green, R.E., *See* McDonnell, F.N., 4:38751
Green, W.L., *See* Barkman, W.E., 4:39263
Greenberg, A.S., *See* Sites, J.R., 4:38370
Greenburg, H.J., Primer and user manual for a Fortran Language Interactive Processor (FLIP), 4:40033 (DOE/EIA—0103/25)
Greene, G.A., Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries, 4:38791 (BNL-NUREG—25714)
Greenhough, P., Mining machine, 4:38108
Greenwald, A., Dielectric guide controlled collective ion acceleration, 4:39385 (CONF-771035—P2, pp 553-564)
Greer, R.T., *See* Wheelock, T.D., 4:38044
Grenier, G., *See* Cance, M., 4:39927
Grieshaber, H., *See* Stumpp, G., 4:39062
Griffin, R.A., Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB—287140)
Grillo, A., *See* del Papa, C., 4:39816
Grindrod, A., Oxide thickness monitor, 4:39506 (N—78-28429)
Griscom, R.W., *See* Littman, F.E., 4:39585
Grisham, D.L., Monitor 1979, 4:39451 (LA-UR—79-689)
Grishman, D.L., *See* Agnew, L., 4:39450
Groom, D.J., Monitoring, evaluation and reporting of radioactive liquid and gaseous effluent releases from the CEGB nuclear power stations, 4:38766
Grosse, E., *See* Bjorstad, P., 4:40043
Gruen, D.M., *See* Liu, M.B., 4:39099
See Steinbruechel, C., 4:39098
Grummitt, W.E., Problems of monitoring radioactive effluents, 4:38767
Gryazev, V.M., Radioactivity of long-lived nuclides in the primary circuit of the reactor BOR-60 during operation with defective fuel elements, 4:38682 (KFK-tr—576)
Guay, R.L., *See* Adamski, J.L., 4:39381
Guckert, L.G., Oil recovery by carbon dioxide injection. Annual report, July 1977—July 1978, 4:38142 (ORO—5301-34)
Guenther, P., *See* Smith, A., 4:39909
Guest, G.E., *See* Waltz, R.E., 4:39969
Guiffre, M.S., Information base for waste repository design. Volume 5. Decommissioning of underground facilities, 4:38268 (NUREG/CR—0495(Vol.5))
Guirlet, J., *See* Miribel, J., 4:38738

Gull, G.E., Far infrared polarization of the Kleinmann—Low nebula in orion, 4:39733 (N—78-28025)
See Melnick, G., 4:39732
Gullickson, R.L., *See* Pasour, J.A., 4:39390
Gunaji, N.N., Geothermal application feasibility study for the New Mexico State University campus. Technical report, 4:38550 (NMEI—13)
Gunion, J., *See* Brodsky, S.J., 4:39842
Gureev, D.M., Optically pumped Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ heterojunction lasers with matched gratings at the interface, 4:39309
Gusek, J.J., *See* Link, J.M., 4:38186
Gustke, F.R., In Situ Environmental Sampler (IES): descriptive analysis and operating procedures, 4:39507 (SAND—78-1342)
Gyulassy, M., Multipion production in nuclear collisions, 4:39934 (LBL—8758)

H

Haar, W., *See* Fischer, W., 4:38851
Haber, I., Steady state transport of high current beams in a focused channel. Interim report, 4:39770 (AD-A—059882)
Hackel, L.A., Hyperfine structure measurements of high-lying levels of uranium, 4:39787
Haddad, C., *See* Chapus, E.E., 4:38336
Haffner, D.R., Reactor physics parameters of alternate fueled FBR core designs, 4:38668 (HEDL-SA—1329)
Haggard, K., Office building for an era of transitions: application of the skytherm system of passive heating and cooling to a moderate density office building, 4:38427 (CONF-780337—P1, pp 5p, Book 3, Paper 3)
See Cooper, P., 4:38424
Haimson, B.C., *See* Hanson, M.E., 4:38181
Haines, B.A., *See* Davies, R.D., 4:38888
Halama, H.J., Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
See Aggus, J., 4:39437
Halawa, T., Problems of country power system automation, 4:38615
Halbig, J.K., *See* Hsue, S.T., 4:38239
Hale, G., Theory and evaluation of nuclear cross sections: fusion reactions, 4:39884 (LA—7722-PR, pp 1-10)
Hale, G.J., Deposition of aluminum—copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX—613-2173)
Hale, G.M., Summary documentation for ^{4}He, 4:39883 (LA—7663-MS, pp 26-39)
Summary documentation for ^{6}Li, 4:39892 (LA—7663-MS, pp 40-48)
Summary documentation for ^{10}B, 4:39893 (LA—7663-MS, pp 54-62)
Halford, G.R., Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
Hall, J.H., *See* Elsaesser, F.L., 4:38588
Hallenbeck, P.C., *See* Benemann, J.R., 4:38310
Halliday, L.A., Energy use in the New Zealand textile industry, 4:39030
Halligan, J.E., Processing of lignite for petrochemicals, 4:38069
Hamidi, H., *See* Edalat, M., 4:38706
Hamill, P., One-dimensional model of the stratospheric aerosol, 4:39577
Hamm, M., *See* Bowman, J.D., 4:39818
Hammond, P.R., Self-absorption of molecular fluorescence, the design of equipment for measurement of fluorescence decay, and the decay times of some laser dyes), 4:39297
Hampton, B.F., A triggered co-ordinating gap for metalclad substations, 4:38611 (N—78-28360)
Hampton, N.F., Water related constraints in energy production. Final report, 4:38879 (PB—285713)
Hamstad, M.A., *See* Bunch, R., 4:39103
Hamza, A., *See* Witherow, J.L., 4:39044
Hanbaba, P., Increased productivity in power plants by the computer-based information system PRAUT, 4:38567 (AED-Conf—78-155-017)
Hancock, P., *See* Antunes, V.T.A., 4:39138
Hanenburg, W.H., *See* Bischoff, W.S., 4:38540, 4:38543
Haney, J., *See* Goranson, C., 4:38526
Hanks, R.W., *See* Smoot, L.D., 4:38067
Hanlon, L.R., Development of intercalated graphite materials. Final technical report 1 August 1976—30 September 1977, 4:39186 (AD-A—057503)
Hannemann, R.J., *See* Hymowitz, E.W., 4:38474
Hannum, D.W., *See* Wawersik, W.R., 4:39727
Hans, J.M. Jr, Miscellaneous data and information collected during radiation surveys at the former Monument Uranium Mill site (1974—1975). Technical note, 4:38287 (PB—285938)
Hansborough, L.D., Mechanical technologies for PIGMI, 4:39447 (LA-UR—79-651)
Hanson, D.L., *See* Flynn, E.R., 4:39904
Hanson, G., *See* Heile, F.B., 4:39846
Hanson, M.E., LLL gas stimulation program. Quarterly progress report, October—December 1978, 4:38181 (UCRL—50036-78-4)
Some results from continuum mechanics analyses of the hydraulic fracturing process, 4:38182 (UCRL—81707)
Hanson, M.S., *See* Larson, D.E., 4:38255
Hard, E.N., Status of FFTF startup program and future FFTF utilization, 4:38778 (HEDL-SA—1671)
Hardekopf, R.A., *See* Flynn, E.R., 4:39904
Hardie, R.W., *See* Haffner, D.R., 4:38668
Hardy, J.E., *See* Eads, B.G., 4:38794
Hargreaves, W.J., *See* Adkins, J.H., 4:38099
Harker, Y.D., *See* Rogers, J.W., 4:38779
Harkness, J.D., Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N—78-31540)
Harleman, D.R.F., Hydrothermal modeling techniques associated with waste heat disposal, 4:39623
Harless, C.E., Tool for cutting insulation from electrical cables, 4:39266
Harlow, F.H., *See* Daly, B.J., 4:38813
Harms, J., *See* Weitkamp, C., 4:39542
Harpman, W.B., *See* Mahoney, F.G., 4:39058
Harrar, J.E., Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL—52640)
Harries, J.E., Remote sensing of atmospheric pollution from space, 4:39549 (N—78-30725)
Harris, B.J., Gaps in the essential spectra of Schroedinger and Dirac operators, 4:39963 (N—78-30886)
Harris, C.L., Statistics for simplification, 4:40040 (MHSMP—79-42)
Harris, D.R., *See* Bokharee, S.A., 4:39444
Harris, G.S., Energy scenarios: details of supplementary studies, 4:38913
Harris, L.A., SEM observations and EDX analyses of secondary mineralization in a bituminous coal, 4:38082 (CONF-790418—4)
Harris, M.J., Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL—78-65(Pt.2), pp 55-69)
See Wittenberg, L.J., 4:38492
Harris, W.F., Terrestrial Ecology Section, 4:38091 (ORNL—5508, pp 117-135)
Harrison, D.C., Harrison residence: Placitas, New Mexico, 4:38441 (CONF-780337—P2, pp 3p, Book 2, Paper 11)
Harrison, G.F., Low cycle fatigue behavior of Nimonic 90 at elevated temperature, 4:39139
Harrison, T.D., Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND—78-0982)
Harrison, W., Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater, 4:38161 (ANL/WR—79-3)
Harrowell, R.V., Superconducting disc alternator, 4:39271 (N—78-28354)
Harsha, P.T., *See* Blazowski, W.S., 4:38592
Harting, P.E., Standardized calculation of cooling towers, 4:38573 (NP—23707)
Hartman, J.S., *See* Lessor, D.L., 4:39514
Hartman, S., *See* Devitt, T., 4:38602
Hartwig, E.C., PEP II RF system, 4:39479 (LBL—8887)
Harvey, E.H., *See* Dris, M., 4:39826
Harwit, M., *See* Gull, G.E., 4:39733
See Melnick, G., 4:39732
Harwood, L.H., *See* Lumpkin, A.H., 4:39891
Hase, H., *See* Baba, K., 4:38536
Hasegawa, J., *See* Baba, K., 4:38536
Haselton, H.H., *See* Stirling, W.L., 4:40011
Hashim, J., Understanding of the importance of Arab/Islamic funds available for development projects and economic support, 4:38871
Hastings, J.B., Separated function focusing monochromator system for synchrotron radiation, 4:39463
Hastings, S.R., Comprehensive approach to window design for energy conservation, 4:38458 (CONF-780337—P3, pp 5p, Book 2, Paper 3)
Hatcher, C.R., *See* Hsue, S.T., 4:38239
Hatori, T., *See* Watari, T., 4:39964
Hawryluk, R.J., Effect of current profile evolution on plasma-limiter interaction and the energy confinement time, 4:39980 (PPPL—1534)
See Dylla, H.F., 4:40024
Hayakawa, M., *See* Baba, K., 4:38536
Hayashi, S.A., *See* Bokharee, S.A., 4:39444
Hazeltine, R.D., *See* Strauss, H.R., 4:39991
Hazi, A., *See* McCann, K.J., 4:39797
Heathcock, R.E., Graphite beds for coolant filtration at high temperature, 4:38648
See Drolet, T.S., 4:38646
Heatherly, L., *See* Clausing, R.E., 4:40022
See Emerson, L.C., 4:40027
Hebel, W., Irradiation techniques at BR2 reactor, 4:38782 (INIS-mf—4426, pp X.1-24)
See Gaertner, M., 4:38802
Heck, E.N., *See* Leggett, R.D., 4:38672
Hedlund, J.D., *See* Klepper, E.L., 4:38271
Hedman, P.O., *See* Smoot, L.D., 4:38067
Heese, R., *See* Krinsky, S., 4:39468
Hegner, S.J., Set-theoretic foundations of data-structure representation, 4:40044
Heile, F.B., Anomalous $e^+ e^-$ and $\mu^+ \mu^-$ events produced in $e^+ e^-$ annihilation, 4:39846
Heinemann, K., Concept for the monitoring of airborne radioactive effluents from nuclear plants in the

Federal Republic of Germany with application to the Juelich Nuclear Research Center, 4:38768
Heinrich, K.F.J., *See* Pella, P.A., 4:39212
Heitz, L.F., Some hydrologic analysis techniques, 4:38329
Helbig, H.F., *See* Prince, E.T., 4:39192
Helland, K.N., Spectral variance estimation and the analysis of turbulence data, 4:39983
Hellermann, G.R., *See* Billen, D., 4:39642
Hellickson, M.L., *See* King, L.D., 4:39657
Helm, R.H., Modeling a horizontal wiggler in an electron storage ring, 4:39480 (SLAC-PUB—2255)
Helmick, H.H., *See* Schneider, R.T., 4:38788
Hemming, D.F., Energy analysis and oil shale reserves, 4:38187 (N—78-31584)
The relative costs of producing syncrude from oil shales of various grades under varying conditions, 4:38197 (N—78-31268)
Hemphill, L., Thermal regeneration of activated carbon, 4:38166 (PB—284065)
Hemsath, K.H., Method and apparatus for effecting uniform heat transfer in an industrial furnace, 4:39345
Henderson, C.F., *See* Peet, N.J., 4:38940
Henderson, D.J., *See* Kaufman, S.B., 4:39901
Henderson, P.A., *See* Johnson, B.B., 4:39031
Henderson, T.F., *See* Green, M.I., 4:39458
Hendricks, R.W., *See* Schaefer, D.W., 4:39181
Hendrie, D.L., *See* Gelbke, C.K., 4:39915
Henning, C.B., *See* Lloyd, E.L., 4:39675, 4:39685
See Serio, C.S., 4:39676
Henning, M.J., *See* Nair, S., 4:38725
Henry, A.L., *See* Taasevigen, D.K., 4:39706
Hensley, D., *See* Maguire, C.F., 4:39902
Herb, S.W., *See* Vidal, R., 4:39828
Heredy, L.A., *See* Skowronski, R.P., 4:38076
Herrera, J., *See* Aggus, J., 4:39437
Herskovitz, M.B., *See* Eads, B.G., 4:38794
Herther, M., *See* Salvesen, K.G., 4:39565
Hesboel, R., *See* Stroem, L.H., 4:39489
Hess, B.W., Analytical modeling techniques of a lattice-type tower. Master's thesis, 4:38613 (PB—285190)
Hess, W.N., The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB—285805)
Hester, R.D., *See* McCormick, C.L., 4:39235
See Wildman, G.C., 4:39236
Hetrick, D.M., Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons, 4:39900 (ORNL/TM—6637)
Hetsroni, G., Workshop proceedings: flow-induced vibrations, 4:38736 (EPRI-WS—78-125)
Heusch, C.A., *See* del Papa, C., 4:39816
Hibino, M., Exhaust gas recirculation apparatus for an internal combustion engine, 4:39055
Hicks, B.B., *See* Wesely, M.L., 4:39529
Hicks, D.L., *See* Swegle, J.W., 4:39810
Hicks, H.R., *See* Waddell, B.V., 4:39992
Hidaka, K., Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target, 4:39868
Hidekuma, S., *See* Watari, T., 4:39964
Hilbert, R.F., *See* Leggett, R.D., 4:38672
Hildebrand, S.G., *See* Kroodsma, R.L., 4:38089
Hildenbrand, D.L., Model calculations of the thermochemical properties of gaseous metal halides. Interim report, 4:39219 (AD-A—059503)
Hill, J.A., *See* Brogan, T.R., 4:38973
Hill, J.R., *See* Argo, P.E., 4:39765
Hill, K.W., *See* Bitter, M., 4:39973
See Murakami, M., 4:39970
Hill, M.D., Status report for the United Kingdom, 4:38278
Hillstrom, K.E., Simulation test approach to the evaluation of nonlinear optimization algorithms, 4:40046
Hilton, M.L., Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM—40)
Hiraing, C.R., *See* Loehoeiden, G., 4:39913
Hirshberg, A., *See* Davidoff, P., 4:38359
Hirshman, S.P., Turbulent destabilization and saturation of the universal drift mode in a sheared magnetic field, 4:39995
Hitchcock, D.R., Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976—February 1977, 4:39563 (PB—285059)
Hitosugi, T., *See* Baba, K., 4:38536
Hitterman, R.L., *See* Faber, J. Jr., 4:39173
Hladky, E., *See* Moravek, J., 4:38737
Ho, K., *See* Louie, S.G., 4:39159
Ho, K.M., Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
See Pickett, W.E., 4:39156
Hoagland, L.C., Micro-isotope tool wear detector, phase I - Final report. Report for 1 October 1977—31 May 1978, 4:38305 (PB—284699)
Hoaglin, G.J., *See* Bischoff, W.S., 4:38540, 4:38543
Hobbins, R.R., *See* Cook, B.A., 4:38797
See Kerwin, D.K., 4:38796
Hobbs, S.H., *See* Peet, N.J., 4:38940
Hochuli, U.E., *See* Peruso, C.J., 4:39290
Hodges, L., *See* Block, D.A., 4:38469
Hoehing, W.W., Apparatus and method to control process to replace natural gas with fuel oil in a natural gas burner, 4:39346
Method and apparatus to replace natural gas with vaporized fuel oil in a natural gas burner, 4:39348
Hoehlein, B., ADAM I - methanation pilot plant, 4:38716 (Juel—1433)
Hofer, G., Measurement of residual stresses in claddings, 4:39131
Hoff, E., *See* Mazria, E., 4:38445
Hoffman, C.M., *See* Bowman, J.D., 4:39818
Hoffman, E.W., *See* Macek, R.J., 4:39406
Hoffman, H.W., *See* Eissenberg, D.M., 4:38838
Hoffman, T.J., Sputtering calculations with the discrete-ordinates method, 4:39781
Hofmann, I., Transverse stability in an electron ring accelerator, 4:39386 (CONF-771035—P2, pp 565-576)
Hofstadter, R., *See* Bowman, J.D., 4:39818
Hogstrom, K., *See* Paciotti, M., 4:39453
Holbeck, J.J., Siting issues for solar thermal power plants with small community applications, 4:38406 (N—78-30663)
Holcombe, L.J., Characterization of carbide lime to identify sulfite oxidation inhibitors. Final report Sep 77-Jul 78, 4:38606 (PB—286646)
Holdt, S.S., *See* Mushotzky, R.F., 4:39739
Holeman, D., *See* Glaros, S.S., 4:40021
Holland, R.E., Absolute cross sections for three-body breakup reactions ^{6}Li(d,n ^{3}He)^{4}He and ^{6}Li(d,p ^{3}H)^{4}He, 4:39894
Hollands, K.G.T., Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974—31 January 1976, 4:38495 (PB—283783)
Hollenberg, G.W., BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME—78-103)
Holloway, L.E., *See* Kirk, T.B.W., 4:39825
Holloway, P.H., Preferential sputtering of Ta_2O_5 by argon ions, 4:39776
See Madden, H.H., 4:39233
Hollowell, C.D., *See* Turiel, I., 4:39010
Hollowell, C.G., Indoor air quality in energy-efficient buildings, 4:38995 (LBL—8892)
Holman, G.S., *See* Lu, S.C., 4:38821
Holmberg, R.C., *See* Agnew, L., 4:39450
Holmes, D.K., *See* Hoffma..., T.J., 4:39781
Holmes, J.A., *See* Waddell, B.V., 4:39992
Holmes-siedle, A., Radiation effects. Engineering handbook (methods of improving the radiation tolerance of electronics in space vehicles). Final report, 4:39503 (N—78-30544)
Holroyd, R.A., *See* Sowada, U., 4:39250
Holt, B.R., *See* Brown, S.L., 4:39553
See Ruff, R.E., 4:39554
Holt, E.C. Jr, An engineering/economic analysis of coal preparation plant operation and cost. Final report, 4:38120 (PB—285251)
Holt, L., *See* Giese, R., 4:38897
Holt, S.A., *See* Mushotzky, R.F., 4:39741
Holt, S.S., *See* Pravdo, S.H., 4:39740
Holte, H.O., Who's Who III in the Interagency Energy/Environment R and D Program, 4:38892 (PB—284228)
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB—284375)
Holten, D.C., Rupture-safe pressure transducers, 4:39509 (UCRL—82358)
Holtz, M.J., Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL—8814)
Holtzman, R.B., Design, construction, and operation of a new radon transfer system, 4:39256 (ANL—78-65(Pt.2), pp 127-137)
Late excretion of ^{231}Pa and its decay products, 4:39690 (ANL—78-65(Pt.2), pp 171-173)
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL—78-65(Pt.2), pp 174-175)
Progress report on a study of contamination of the human food chain by uranium mill tailings piles, 4:39600 (ANL—78-65(Pt.2), pp 176-194)
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL—78-65(Pt.2), pp 109-110)
See Rundo, J., 4:39679
Holve, D., *See* Ariessohn, P., 4:38966
Hombach, H.P., *See* Collins, C.J., 4:38071
Hong, J.Y., *See* Singh, C.M., 4:39997
Honig, E., *See* Warren, R., 4:40009
Hooper, A.T., Some considerations of operating nuclear powered dual purpose electricity/water installations, 4:38710 (IAEA—206, pp 109-115)
Hoppe, P., Noise analysis performed at the sodium cooled power reactor KNK 1 for malfunctioning diagnosis and plant surveillance, 4:38693
Hopper, R.W., Appendices to "On the dependence of necking upon loading history", 4:39806 (UCID—18161)
Horikawa, K., *See* Matsumoto, S., 4:39329
Horsch, F., *See* Bayer, A., 4:38824
Horton, R., *See* Bitter, M., 4:39973
Horyna, J., Monitoring of radioactive airborne releases in the NRI Rez, 4:38769
Hosaka, A., *See* Asano, M., 4:39060

Hosaka, M., Analytical study of solids-gas two phase flow, 4:38689 (UTNL-R—0046, pp 23-31)
Hosford, C.D., *See* Lowe, A.T., 4:40018
Hotchkiss, G.B., Comparison of three experimental methods used in determining the thermal performance of flat-plate solar collectors. Ph.d. thesis - Kansas Univ, 4:38493 (N—78-28614)
Houck, J.R., *See* Gull, G.E., 4:39733
Houser, C.A., *See* Tsong, I.S.T., 4:39213
Houston, J.E., *See* Rye, R.R., 4:39241
Howard, D., *See* Jarrett, J., 4:38921
Howard, J.B., *See* Bush, T.W., 4:38080
Howe, H.C., *See* Murakami, M., 4:39970
Howell, R.H., Positron lifetime study of copper irradiated by energetic protons or energetic neutrons, 4:39169 (UCRL—82159)
Howerton, W.B., *See* Clark, W.E., 4:38240
See Lin, K.H., 4:38250
Howington, L.C., Microcomputer-based video motion detection system, 4:38299 (Y/DA—7999)
Hradcovsky, R.R., Lead crystal storage cells and storage devices made therefrom, 4:38855
Hren, J.J., *See* Stimetz, C.J., 4:39101
Hruby, V., *See* Cole, J., 4:38975
Hsue, S.T., Passive neutron assay of irradiated nuclear fuels, 4:38239 (LA—7645-MS)
Hu, C., *See* Panitz, J.K.G., 4:39180
Hu, M.C., Water consumption and costs for various steam electric power plant cooling systems. Final report, October 1977—January 1978, 4:38575 (PB—285397)
Huba, J.D., High frequency drift waves with wavelengths below the ion gyroradius in equatorial spread F. Interim report, 4:39761 (AD-A—058246)
Lower-hybrid-drift wave turbulence in the distant magnetotail. Interim report, 4:39766 (AD-A—058245)
See Gladd, N.T., 4:39993
Hubschmann, W., *See* Bayer, A., 4:38824
Huddle, R.A.U., Metallurgical problems of the He-to-He heat exchanger for advanced HTR's, 4:38719
Hudgings, D.W., Neutral beam injection for a proton storage ring, 4:39432 (LA-UR—79-703)
See Meger, R.A., 4:39389
Hudson, E.D., *See* Ball, J.B., 4:39441
Hudson, J.D., *See* David, S.A., 4:39092
Huerta, M., *See* Yoshimura, H.R., 4:39279
Huff, D.D., *See* Ward, D.S., 4:38260
Huff, D.R., *See* Essling, M.A., 4:39689
See Rundo, J., 4:39683
Huffman, W.J., *See* Halligan, J.E., 4:38069
Hughes, E.B., *See* Bowman, J.D., 4:39818
Hughett, J., Boring proves exciting way to cross river, 4:38185 (CONF-7611113—, pp 4p, Paper 5)
Huizenga, J.R., Role of the conservative potential and dissipation in heavy-ion fusion, 4:39932 (COO—3496-70)
Hull, L., Analysis of meteorological conditions during the 1977 Anclote Keys Plume Study. Final report, February—November 1977, 4:39559 (PB—284905)
Humphries, S. Jr., *See* Johnson, D.J., 4:39780
Humphries, T.S., Corrosion inhibitors for solar heating and cooling systems, 4:38473 (N—78-30202)
Humphry, F.J., *See* Potter, J.M., 4:39401, 4:39449
Hundemann, A.S., Power plant siting (A bibliography with abstracts). Report for 1964-September 1978, 4:38760 (NTIS/PS—78/1007)
Solar space heating and air conditioning. volume 2. 1976-august, 1977 (citations from the NTIS data base). Report for 1976-August 1977, 4:38475 (NTIS/PS—78/1014)
Solar space heating and air conditioning. volume 3. September, 1977-september, 1978 (citations from the ntis data base). Report for September 1977-September 1978, 4:38476 (NTIS/PS—78/1015)
Solar space heating and air conditioning. volume 3. September, 1977-September, 1978 (citations from the Engineering Index data base). Report for sep 77-sep 78, 4:38477 (NTIS/PS—78/1017)
Hundstad, R.L., *See* Babcock, R.V., 4:39299
Hunt, A.J., Small particle heat exchangers, 4:38407 (LBL—7841)
Hunt, C.M., Air leakage measurements in three apartment houses in the Chicago area, 4:39005 (PB—283722)
Hunt, M.B., California's passive program, 4:38364 (CONF-780337—P1, pp 5p, Book 1, Paper 6)
Hunter, E.E., Inelastic electron scattering in $_{28}$si between 4 MeV and 50 MeV excitation energy. Master's thesis, 4:39899 (AD-A—057898)
Huria, H.C., *See* Mohanakrishnan, P., 4:38727
Husar, J.D., *See* White, W.H., 4:39575
Husar, R.B., Determination of ambient H_2SO_4 and it's ammonium salts by in situ aerosol thermal analysis, 4:39574
See White, W.H., 4:39575
Hutchins, F.P., Investigation of turbo-dyne energy chamber (G:R:Valve trademark) - an air bleed device, 4:39057 (PB—285381)
Huth, G., *See* Baresel, D., 4:39086
Hvelplund, P., *See* Moak, C.D., 4:39170
Hwa, R.C., Parton recombination model, 4:39852 (DOE/ER/70004—207)
Hyde, J.D., *See* Burnell, L.K., 4:39356
Hymowitz, E.W., Greenbelt community project: solar energy retrofit for a multi-family dwelling, 4:38474 (N—78-31539)

I

Ignatiev, A., *See* Zajac, G., 4:38502
Igo, G., *See* Stetz, A., 4:39847
Iimura, H., Development of a monitoring device for noble gas nuclides in the stack effluent of a BWR nuclear power plant, 4:38735
Ikuta, K., Plasma flow driven by fusion-generated alpha particles, 4:39965 (N—78-27917)
Il'chishin, I.P., Tuning of the emission frequency of a dye laser with a Bragg mirror in the form of a cholesteric liquid crystal, 4:39312
Ilcewicz, F.H., *See* Holtzman, R.B., 4:39690
See Rundo, J., 4:39687
Im, K.H., *See* Johnson, T.R., 4:38962
Iman, R.L., *See* Conover, W.J., 4:40037
Incropera, F.P., Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report, 4:39041 (PB—285709)
Ingwell, T., *See* Callender, J., 4:39726
Innes, W.R., *See* Vidal, R., 4:39828
Inoue, H., *See* Paciotti, M., 4:39453
Intyashin, A.D., Use of water-soluble petroleum sulfo acids for stimulating well operations, 4:38147
Ireland, S.J., *See* Holbeck, J.J., 4:38406
Isaacs, N.P., *See* Harris, G.S., 4:38913
Iserov, A.D., *See* Sheindlin, A.E., 4:38953
Ishida, M., *See* Matsumoto, S., 4:39329
Ishizuka, A., *See* Iimura, H., 4:38735
Islamov, F.Ya., *See* Gabdrakhmanov, A.G., 4:38156
Isler, R.C., *See* Murakami, M., 4:39970
Ito, Y., *See* Seikieka, M., 4:38549
Ivanov, P.P., *See* Bitiurin, V.A., 4:38955
Ivenskii, A.P., *See* Luzyanin, G.S., 4:38154
Ivkin, M.V., *See* Demidov, B.A., 4:39395
Iwan, A., *See* Maloszewski, J., 4:38109
Izgorodin, V.M., *See* Grasyuk, A.Z., 4:39310

J

Jackson, J., *See* Allinger, J., 4:39436
Jackson, J.L., *See* Hollenberg, G.W., 4:38754
Jackson, J.M., *See* Hoehing, W.W., 4:39346
Jackson, R., *See* Longley, W.L., 4:38163
Jackson, W.B., Environmental assessment of an active oil field in the northwestern Gulf of Mexico, 1976—1977. Annual report, 4:38165 (PB—283890)
Jackson, W.L., *See* Ellison, R.D., 4:38992
Jacobson, K.B., Mechanism of suppression in Drosophila. VII. Correlation between disappearance of an isoacceptor of tyrosine tRNA and activation of the vermilion locus, 4:39645
Jacobson, W.O., *See* Bischoff, W.S., 4:38540, 4:38543
Jacquemet, A., *See* Baumgartner, H., 4:39349
Jacquemin, J., *See* Schmitz, G., 4:38775
Jaeger, T.A., Advances in fracture mechanics analyses of primary system performance under operating and accident conditions, 4:39119 (INIS-mf—4506, pp v)
Analysis of cracks by means of FEM, 4:39121 (INIS-mf—4506, pp v)
Application of the J-integral concept to cracks emanating from a hole, 4:39111 (INIS-mf—4506, pp v)
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf—4506, pp v)
Assessment of the integrity of PWR pressure vessels. A U.K. study group report, 4:38805 (INIS-mf—4506, pp v)
Crack initiation and growth in welds at 1100°F (593°C), 4:39120 (INIS-mf—4506, pp v)
Cracked element approach for the computation of stress intensity factors, 4:39125 (INIS-mf—4506, pp v)
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf—4506, pp v)
Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures, 4:39118 (INIS-mf—4506, pp v)
Enhancement of the quality of the reactor pressure vessel used in light water power plants by advanced material fabrication and testing technologies, 4:39127 (INIS-mf—4506, pp v)
Finite element analysis of crack propagation problems for the fracture mechanics evaluation of reactor vessel nozzle junction, 4:38632 (INIS-mf—4506, pp v)
Finite element elastic-plastic analysis of initiation and stable crack growth in

three-point bending, 4:39113 (INIS-mf—4506, pp v)
Fracture mechanics practice for crack arrest, 4:39115 (INIS-mf—4506, pp v)
Geometric influences upon stress intensity distributions along reactor vessel nozzle cracks, 4:39124 (INIS-mf—4506, pp v)
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf—4506, pp v)
Improved stress-intensity factors for semi-elliptical surface cracks in finite-thickness plates, 4:39109 (INIS-mf—4506, pp v)
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf—4506, pp v)
Influence of transverse shear on plasticity around an axial crack in a cylindrical shell, 4:39108 (INIS-mf—4506, pp v)
Interpretaion of the instrumented Charpy test, 4:39116 (INIS-mf—4506, pp v)
Method of line applied to 3-D crack problems including plasticity effect, 4:39114 (INIS-mf—4506, pp v)
Methodology for plastic fracture. A progress report, 4:39126 (INIS-mf—4506, pp v)
Nuclear pressure boundary materials research, problems and proposed solutions, 4:39161 (INIS-mf—4506, pp v)
Outer and inner surface flaws in thick-walled pressure vessels, 4:39112 (INIS-mf—4506, pp v)
Pressure vessel fracture safety investigations using as criterion the onset of crack propagation, 4:39122 (INIS-mf—4506, pp v)
Some comments about the J_1 integral criterion in post yield fracture mechanics, 4:39110 (INIS-mf—4506, pp v)
Stable crack growth under sustained load, 4:39123 (INIS-mf—4506, pp v)
Stress intensity factors of corner cracks in two nozzle-cylinder intersections, 4:39117 (INIS-mf—4506, pp v)
Structural dynamic analysis of BWR MARK II plant under SRV blowdown oscillation, 4:38804 (INIS-mf—4492)
Two- and three-dimensional finite element analysis of a central cracked crackgrowth test specimen, 4:38740 (INIS-mf—4506, pp v)
Jaffrin, A., *See* Schneider, M., 4:38461
Jagersberger, H., *See* Winkelmann, I., 4:38777
Jaklevic, J.M., Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL—7999)
See Ramponi, A.J., 4:39544
James, H., *See* Smith, I.J., 4:38787
James, R.K., *See* Kruger, C.H., 4:38965
Jansen, A.J.M., Inviscid fluid motions induced by an electric current source. Part I. Preliminary analysis, 4:39811 (N—78-28388)
Janz, R.F., Analysis of GM fuel economy surveys. Final report, 4:39024 (PB—283946)
Analysis of production cars' fuel economy, 4:39023 (PB—283931)
Janzen, H., Problems with our upgraded 3-MV machine, 4:39365 (LA—7445-C, pp 104-112)
Jarrett, B.M., Development document for the effluent limitations and guidelines for the ore mining and dressing point source category. Volume I. Final report, 4:38224 (PB—286520)
Jarrett, J., State energy management: The California Energy Resources Conservation and Development Commission. (innovations transfer: new approaches by the states), 4:38921 (PB—285062)
Jarvis, G.J., Release of alloying constituents of stainless steel in SGHWR calandria environment, 4:38649
Jasberg, B.K., *See* Wing, R.E., 4:39351
Jassby, D.L., *See* Strachan, J.D., 4:39977
Jaumotte, A.L., Earth, an open system. The use of solar energy, 4:38355
Javan, A., Optical and infrared lasers. Final report, 1 December 1972—31 March 1978, 4:39291 (N—78-28437)
Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77, 4:39284 (AD-A—059429)
Jellison, J.L., Role of surface contaminants in the deformation welding of gold to thick and thin films, 4:39093 (SAND—79-0352C)
Jenkins, D., *See* Mazria, E., 4:38445
Jenkins, G.H., *See* Whitaker, R.B., 4:38506
Jenkins, J.D., *See* Allen, E.J., 4:38226
Jenkins, L.H., Surface studies and catalysis , 4:39146 (LBL—8975, pp 52.-54.)
Jenkins, W.R., *See* Meyer, J.H., 4:39586, 4:39587
Jennison, D.R., *See* Rye, R.R., 4:39241
Jentz, N.E., *See* O'Hara, J.B., 4:38051
Jernigan, T.C., *See* Murakami, M., 4:39970
Jiracek, G.R., *See* Gunaji, N.N., 4:38550
Jirka, G.H., *See* Harleman, D.R.F., 4:39623
Jog, V., *See* Doganoglu, Y., 4:39350
Johansson, L., *See* Bauer, R.S., 4:39189
Johnson, B.B., Energy price levels and the economics of irrigation, 4:39031
Johnson, C.E., Applying new safeguards technology to existing nuclear facilities, 4:38289 (CONF-790430—2)
Johnson, C.K., Structure solution methods for superstructures, 4:39945 (CONF-790342—1)
Johnson, D., *See* Sanghi, A.K., 4:38887
Johnson, D.J., Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
Johnson, D.R., *See* Bader, B.E., 4:38145
Johnson, E.K., Trip report: UCSB earthquake damage survey, 4:39711 (SLAC-TN—79-1)
Johnson, E.R., *See* Hoehing, W.W., 4:39346, 4:39348
Johnson, E.W., *See* Zanotelli, W.A., 4:38820
Johnson, G.G., *See* McCone, A.I., 4:38566
Johnson, H.D., Mechanical properties of LX-10-1 evaluated with the diametric disc test, 4:39517 (MHSMP—79-8)
Johnson, J.N., Calculation of explosive rock breakage: oil shale, 4:38188 (LA-UR—79-646)
Johnson, J.W., *See* Ball, J.B., 4:39441
Johnson, M.A., *See* Hackel, L.A., 4:39787
Johnson, M.E., Bivariate distributions with given marginals and fixed measures of dependence, 4:40038 (LA—7700-MS)
Computer methods for sampling from the gamma distribution, 4:40039 (LA-UR—78-2116)
Johnson, S.A., *See* Solarz, R.W., 4:39251
Johnson, S.S., Savannah River Plant Californium-252 Shuffler software manual, 4:38291 (LA—7717-M)
Johnson, T.R., MHD downstream gas management, 4:38962 (CONF-781009—, pp 501-540)
Jonas, A., *See* Barbeau, D.L., 4:39643
Jonath, A.D., Copper sulfide films deposited by cylindrical magnetron reactive sputtering, 4:39188
Jones, A.T., *See* Emery, A.F., 4:39326
Jones, C.M., *See* Knudsen, H., 4:39940
Jones, E.C. Jr., *See* Ensslin, N., 4:39890
Jones, G.T., Phase 2. Array automated assembly task, low cost silicon solar array project. Quarterly technical report no. 2, April 1—June 30, 1978, 4:38374 (DOE/JPL/954865—3)
Jones, H.T., *See* Powell, J.L., 4:38048
Jones, J.E., *See* Kryter, R.C., 4:38730
Jones, K.W., *See* Slatkin, D.N., 4:39692
Jones, L.W., Antiproton momentum compactor-debuncher linac, 4:39420 (LBL—7574, pp 165)
See Fung, S., 4:39455
Jones, O.C. Jr., *See* Agrawal, A.K., 4:38812
See Greene, G.A., 4:38791
Jones, P.L., Savannah River Laboratory hydrogeochemical and stream sediment reconnaissance. Orientation study data release VII, Wolcott, Vermont, area. National Uranium Resource Evaluation Program, 4:38207 (GJBX—43(79))
Jones, R.T., Phenolic resin composition and a battery separator impregnated therewith, 4:38852
Jones, W.B., *See* Gauster, W.B., 4:39128
Jonsson, V., Simulation of the Krafla Geothermal Field, 4:38518 (LBL—7076)
Joo, L.A., Process for manufacture of positive electrode for lithium/metal sulfide secondary cell, 4:38854
Jordan, H., *See* Gieseke, J.A., 4:38816, 4:38817
Jordan, W., *See* Schuchman, J.C., 4:39330
Joseph, C., Bodcau In Situ Combustion Project. Second annual report, July 1, 1977—June 30, 1978, 4:38144 (SAN—1189-3)
Jost, J.W., *See* Karnesky, R.A., 4:38671
Joubert, J.I., Fuels and combustion, 4:38968
Juenemeann, H., *See* Pott, G, 4:38640
Juergens, E., *See* Crumrine, K., 4:39596
Julian, E.L., *See* Gordon, R.L., 4:38129
Julian, L.C., *See* Gordon, R.L., 4:38129
Jump, M.J., *See* Bastin, J.J., 4:38228, 4:38229, 4:38230
See Corbett, J.A., 4:38297
Jung, M., *See* Read, A.L., 4:39821
Jung, R.G., *See* Gieseke, J.A., 4:38816, 4:38817
Jung, W., *See* Krug, W., 4:38677
Junge, C., Tropospheric aerosols, 4:39535
Junod, A., Meteorological aspects of energy use, 4:39534
Prediction methods of cooling tower plumes: Parts I—II, 4:39588
Juras, R.C., Single-crate stand-alone CAMAC control system for a negative ion source test facility, 4:39426 (CONF-790327—10)

K

Kadyrov, R.R., *See* Yusupov, I.G., 4:38146
Kagan, Ya.M., *See* Akhmetshina, ..Z., 4:38157
Kahn, M.H., Electric utility financial problems and potential solutions. Summary report, 4:38936 (PB—285827)
Kahn, S.A., *See* Cnops, A.M., 4:39819
Kaieda, K., *See* Hsue, S.T., 4:38239
Kaiser, M.L., Direct measurements of the polarization of terrestrial kilometric radiation from Voyagers 1 and 2, 4:39757 (N—78-30758)
Kaiser, R., Technology assessment of advanced composite materials. Phase I. Final report, 4:39171 (PB—283416)
Kajitani, T., Modulated ordering Nb-H alloys, 4:39175 (CONF-790341—4)

See Brun, T.O., 4:39174
Kukegawa, S., *See* Baba, K., 4:38536
Kulafus, R., *See* Bland, R., 4:38172
Kulashnikov, V.M., *See* Yusupov, I.G., 4:38146
Kulinin, A.V., Technique of grouping electrospark sources, 4:39715
Kulinin, V.V., *See* Kulinin, A.V., 4:39715
Kulinowski, T., Methodology of determination in the estimation of power system automation effects, 4:38616
Kulitkin, N.N., *See* Ermakov, V.V., 4:39803
Kulmaru, A.M., *See* Maslennikov, V.M., 4:38960
Kulos, M.H., *See* Phani, M.K., 4:39949
Kulter, R.J., The Presidential energy initiatives: Some relevant policy considerations, 4:38918 (PB—283971)
Kummerud, R.C., *See* Holtz, M.J., 4:38471
Kuneko, Y., *See* Seikieka, M., 4:38549
Kunofsky, A., *See* Dris, M., 4:39826
Kupetanakos, C.A., Astron type equilibrium in the absence of an applied magnetic field, 4:39984
Kupiloff, L., Natural gas shortage. Final report, 4:38178 (PB—283875)
Kuplan, R.A., Energy-efficient oil burner, 4:39347
Kuplan, S.D., *See* Ruff, R.E., 4:39554
Kuplanis, S., *See* Stokstad, R.G., 4:39911
Kupo, P.S., *See* Bastin, J.J., 4:38228
Kurasev, B.G., *See* Andreev, A.M., 4:38683
Kurnesky, R.A., Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA—1543-FP)
See Weber, J.W., 4:38669
Kurney, C.F.F., Nonlinear evolution of lower hybrid waves, 4:39999
Kurpukhin, A.V., *See* Buznikov, A.E., 4:38976
Kursten, G., Possibilities of application of experimental Kfk results from BR2 on SNR designs, 4:38676 (INIS-mf—4426, pp I.1-13)
Kussner, D., *See* Buchanan, V., 4:39472
Kutan, T., Observations of an operating zinc-pore electrode. Interim technical report, 4:38848 (AD-A—059300)
Kuto, S., Method of operating a power plant and apparatus therefor, 4:38580
Kutzer, J.R., Auger and reaction studies of poisoning by sulfur and regeneration of metal synthesis gas catalysts, 4:38312 (LBL—8975, pp 8.-10.)
See Windawi, H., 4:39150
Kuufman, A.N., *See* Mostrom, M.A., 4:39994
Kuufman, S.B., Spallation of aluminum by 300 GeV protons, 4:39901
See Wilkins, B.D., 4:39924
Kuzachkovskii, O.D., Nuclear power and neutron physics, 4:39941 (INIS-mf—4508, pp 14-19)
Kuzanovich, B.B., Air radiator cooling tower, 4:38577
Kuane, A.T., *See* Littma, M.S., 4:39672
Kuane, M.J., The application of optimal control theory to hybrid electric transit systems. Master's thesis, 4:39076 (AD-A—059365)
Kuaton, M.J., *See* Pigford, T.H., 4:38599
Kuddy, E.S., Ceramic heat pipes for high temperature heat removal, 4:39258 (LA-UR—79-332)
Kudl, R.J., *See* Brunton, G.D., 4:38837
Kuefe, D.J., *See* McDowell, W.P., 4:39344
Kuenan, M., *See* Rao, S.T., 4:39558
Kuhs, R.A., *See* Brandt, H.E., 4:39424
Kuiser, J.R., Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM—6660)
Kuith, W., *See* Allinger, J., 4:39436
Kulbaugh, D., Kelbaugh House: recent performance, 4:38450 (CONF-780337—P2, pp 7p, Book 2, Paper 7)
Kuller, N.A., Criticality data for (Pu,U)O_2 fuel, 4:39275 (AECL—5807(rev.1))
Validation of the KENO and SU-HAMMER codes for critical solution systems of U-233 and U-235, 4:39276 (AECL—5917)
Kuller, W.E., Low temperature physics and engineering. Quarterly progress report, July 1—September 30, 1978, 4:39813 (LA—7691-PR)
Kulley, J.H., Mine roof support method and apparatus, 4:38106
Kullizy, A., Outline of cost-benefit analysis and a case study, 4:38390 (N—78-31954)
Kulner, J.M., *See* Dixon, R.L., 4:39280
Kulso, S.M., Properties of the strain-confined electron-hole liquid in Ge as a function of density, 4:39951
Kumeny, L.G., Nuclear power plant operational diagnostics and control, 4:38756
Kummer, A.M., *See* Sherman, P.L., 4:39571
Kumper, K.W., *See* Lumpkin, A.H., 4:39891
Kumpner, L. Jr, *See* Laursen, H.I., 4:38612
Kuniston, S., *See* Quigley, R.W., 4:38425
Kunkeremath, D.C., A program for the environmental assessment of conventional combustion processes. Final task report, March 1977—May 1978, 4:39562 (PB—284974)
Kunnavi, F.A., *See* Kisilenko, B.E., 4:38196
Kunnedy, M., *See* Ruefli, T., 4:38925
Kunzin, F.A., *See* Stepanov, V.P., 4:39712
Kuphart, R.D., *See* Vidal, R., 4:39828
Kurwin, D.K., Fuel rod behavior in a nine-rod bundle tested in film boiling, 4:38796 (CONF-790602—2)
Kussler, R., *See* Cole, J., 4:38975
Kustin, J., Available work in geothermal energy, 4:38531 (COO—4051-25)
Thermodynamic and transport properties of isobutane: a survey of available data, 4:38541 (COO—4051-35)
Kustly, J.D., *See* Bernal, E.L., 4:39260
Kutterer, H.E., *See* Murakami, M., 4:39970
Kutterson, J.B., *See* Bhattacharya, S., 4:39193, 4:39194
Kuy, A.W., *See* Goddard, M.C., 4:39864
Kuyworth, G.A., Neutron physics at LASL, 4:39378
Khalifa, H.E., *See* Kestin, J., 4:38541
Kharchev, V.F., *See* Gaziyants, A.P., 4:38173
Kholin, I.V., *See* Basov, N.G., 4:39311
Khrychev, B.A., *See* Kolchin, G.I., 4:39723
Kiang, C.S., *See* Hamill, P., 4:39577
Kikuchi, A., *See* Fujita, M., 4:38807
Kilyachina, A.V., *See* Perova, G.K., 4:38084
Kim, H., *See* Destler, W.W., 4:39383
See Uhm, H.S., 4:39379
Kim, J., *See* Stirling, W.L., 4:40011
Kim, Y.C., *See* Singh, C.M., 4:39997
Kimberly, W., *See* Taylor, W.E., 4:38372, 4:38373
Kincaid, B.M., *See* Hastings, J.B., 4:39463
Kindle, E.C., *See* Mills, F.S., 4:39546
King, A., *See* Close, E., 4:39483
King, L.D., Projected energy and water consumption of Pacific Northwest irrigation systems, 4:39657 (PNL-RAP—33)
King, N.S.P., *See* Anderson, B.D., 4:39906
King, P.W., *See* Murakami, M., 4:39970
King, R.N., Sulfur cell construction and method, 4:38850
Kinkead, W.K., *See* Zavitsanos, P.D., 4:38045
Kinnison, W.W., *See* Bowman, J.D., 4:39818
Kinsey, V.E., Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968—December 31, 1978J, 4:39668 (COO—2012-38)
Kirby, R.G., *See* Jarrett, B.M., 4:38224
Kirillov, I.R., *See* Andreev, A.M., 4:38683
Kirk, H.G., *See* Cnops, A.M., 4:39819
Kirk, T.B.W., Production of photons associated with the psi by 217-GeV/$c\pi^-$ mesons, 4:39825
Kirkham, D.O., An energy analysis of Tasmanian barley, hops and beer production, 4:39033 (PB—283950)
Kirkin, A.N., Generation of high power ultrashort pulses in a low-temperature ruby laser with a small active volume, 4:39313
Kirkpatrick, F.H., *See* Kostuk, R.K., 4:39649
Kirsh, I.E., *See* Littma, M.S., 4:39672
Kiser, D.L., Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP—1512)
Kisilenko, B.E., Pumping hot water to increase oil yield from fissured-porous seams with highly viscous oil, 4:38196
Kistner, O.C., *See* Baktash, C., 4:39912
Kitazoe, T., Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model, 4:39869
Kizin, V.D., *See* Gryazev, V.M., 4:38682
Klainer, S.M., RDA ruby laser frequency doubler system. Quarterly progress report no. 3, 24 oct 73-23 jan 74, 4:39281 (AD—923260)
Klein, R., *See* Read, A.L., 4:39821
Kleinschmager, H., *See* Fischer, W., 4:38851
Klem, G.J., *See* Banks, N.E., 4:39522
Klemm, H.A., *See* Dennis, R., 4:39550
Klepeis, J.E., Open-cycle disk generator studies, 4:38949 (CONF-781009—, pp 411-414)
Klepper, E.L., Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL—1948)
Klier, K., Advanced methanol synthesis catalysts. Final technical letter report, 4:38323 (PB—286716)
Klier, R., *See* Devitt, T., 4:38602
Klinger, M.I., Mechanism of low-temperature formation of Watkins-type radiation defects in semiconductors, 4:39198
Klose, G., *See* Dowdy, M., 4:39054, 4:39063
Klumpe, H.W., *See* O'Hara, J.B., 4:38051
Klyushin, I.Ya., *See* Kuvandykov, I.Sh., 4:38148
Knappstein, H., Adjustable device for removing pollutants from gases and vapors evolved during coke quenching operations, 4:38088
Kniga, A.A., *See* Maslennikov, V.M., 4:38960
Knight, J.W. III, Reverse current in solar flares, 4:39749 (N—78-31031)
Knight, R.A., *See* Tran, D.Q., 4:38063
Knighton, J.B., Pyrochemical coprocessing of UO_2—PuO_2 LMFBR fuel by the Salt Transport Method, 4:38242 (RFP—2887)
Knoll, M.G., Comparison study of the five transistor-transistor-logic (TTL) families and emitter coupled logic (ECL). Final report, 4:39499 (AD-A—058093)
Knotek, M.L., Analysis of chemistry at ionically bonded surfaces by electron stimulated desorption(a), 4:39225 (LBL—8975, pp 42.-44.)
Knowles, G.R., *See* Lefrois, R.T., 4:38836
Knowlton, T.M., *See* Tran, D.Q., 4:38063
Knudsen, H., Total electron-loss cross sections and absolute charge state

yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
See Moak, C.D., 4:39170
Kobayashi, A., *See* Iimura, H., 4:38735
Kobayashi, K., Exhaust gas purification system, 4:39083
Koehler, D.E., Performance characteristics of automotive engines in the United States. Third series - Report No. 1. 1977 Volvo 130 CID (2.1 liters), f. i. Interim report, November 1977, 4:39067 (PB—286077)
See Chamberlain, T.W., 4:39065, 4:39066
Koekiewicz, A., *See* Halawa, T., 4:38615
Koester, J.K., Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009—, pp 603-634)
Koester, L.J., *See* Kirk, T.B.W., 4:39825
Kogut, J., *See* Fischler, W., 4:39875
Kohama, H., Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas, 4:39355
Kok, B., Biological solar energy conversion approaches to overcome yield stability and product limitations. Progress report no. 6, 1 October 1977-31 March 1978, 4:39555 (PB—284823)
Kok, K.D., *See* Denning, R.S., 4:38942
Kolak, N.P., *See* Burnell, L.K., 4:39356
Kolb, C.E., *See* Wormhoudt, J.C., 4:38982
Kolbe, W.F., *See* Zoellner, W.D., 4:39494
Kolchin, G.I., Use of data from deep seismic probing in the interpretation of gravimetric data, 4:39723
Kolchin, Y.A., Investigation of a pulsed chemical H_2—F_2 laser at high pressures of the working mixture, 4:39314
Kolchina, G.I., *See* Andreev, A.P., 4:39721
Kolhatkar, M.G., *See* Kotrappa, P., 4:38770
Kolomensky, A.A., Autoacceleration of electron beam and microwave radiation in the diaphragmed waveguide, 4:39387 (CONF-771035—P2, pp 577-583)
REB focusing and transport investigations, 4:39396 (CONF-771035—P2, pp 793-805)
Kolovskii, V.B., *See* Kolchin, Y.A., 4:39314
Komaki, T., *See* Matsumoto, S., 4:39329
Kominek, E.G., Future needs and the impact on the water and waste quipment manufacturing industry due to the use of synthetic fuels, 4:38085 (EPA—600/7-78-063, pp 535-543)
Komissarov, A.I., *See* Tosunov, E.M., 4:38149
Kondrat'ev, O.K., *See* Berzon, I.S., 4:39713
Kononenko, W., *See* Dris, M., 4:39826
Konoshenko, A.F., *See* Bashkin, A.S., 4:39318
Konyaev, V.P., *See* Borodulin, V.I., 4:39316
Konyukhov, V.K., Possibility of building a gasdynamic laser utilizing transitions between levels of paired CO_2 modes, 4:39306
Koplick, C.M., Information base for waste repository design. Volume 1. Borehole and shaft sealing, 4:38264 (NUREG/CR—0495(Vol.1))
Information base for waste repository design. Volume 2. Equipment performance requirements, 4:38265 (NUREG/CR—0495(Vol.2))
Information base for waste repository design. Volume 3. Waste/rock interactions, 4:38266 (NUREG/CR—0495(Vol.3))
Information base for waste repository design. Volume 6. Excavation technology, 4:38269 (NUREG/CR—0495(Vol.6))
See Bartlett, J.W., 4:38270
See Byrne, R.J., 4:38267
See Guiffre, M.S., 4:38268
Koppers, M., Hydraulic mine prop, 4:38107
Korchagin, Yu. S., *See* Gaziyants, A.P., 4:38173
Koriagina, G.M., *See* Bitiurin, V.A., 4:38955
Kormanik, P.P., Comparison of sludge and fertilizer applications on establishment and growth of seedlings of two sweetgum ecotypes endomycorrhizal with Glomus mosseae and G. etunicatus. Establishment and progress report, 4:39658 (SRO—0870-5)
Kormer, S.B., *See* Grasyuk, A.Z., 4:39310
Korsakov, V.S., Technology of reactor construction, 4:38623
Kortovich, C.S., Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80, 4:39135
Koshelev, V.I., *See* Baksht, R.B., 4:39394
Kostuk, R.K., Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR—3490-1480)
Kotomseva, K.A., *See* Samson, A.M., 4:39319
Kotrappa, P., Monitoring procedures for effluent releases from nuclear facilities at Trombay, 4:38770
Kotschi, H., *See* Becker, D.E., 4:38742
Kouts, H.J.C., *See* Steinberg, M., 4:38225
Kovbasiuk, V.I., *See* Antonov, B.M., 4:38977
Kowalik, R.M., *See* Kruger, C.H., 4:38965
Kowalski, A., *See* Halawa, T., 4:38615
Koyama, H., *See* Iimura, H., 4:38735
Kozak, O.R., *See* Hradcovsky, R.R., 4:38855
Kozeki, T., *See* Matsumoto, S., 4:39329
Kozlov, Y.I., Influence of photoinitiating substances on stimulated emission from a chemical HF laser, 4:39315
Kozlova, E.F., Technique and results of interpreting gravimetric data for investigating the deep geological structure of the Russian plate, 4:39720
Kozlovskii, V.I., Possibility of lowering the acceleration voltage of a laser electron-beam tube, 4:39308
Kraihanzel, C.S., *See* Klier, K., 4:38323
Kraimer, M.R., *See* Smith, R.P., 4:38958
Krakowski, R.A., *See* Moses, R.W., 4:40001
Kramer, W., In-pile investigation of local cooling disturbance in LMFBR's (Mol 7C), 4:38803 (INIS-mf—4426, pp II.1-13)
Kraner, H.W., *See* Slatkin, D.N., 4:39692
Kranig, J.M., *See* Hutchins, F.P., 4:39057
Krastelev, E.G., *See* Kolomensky, A.A., 4:39396
Krause, H.F., Carbon reaction studied by crossed molecular beams), 4:39786
See Moak, C.D., 4:39170
Kraushaar, J.J., *See* DiGiacomo, N.J., 4:39907
Krauss, A.R., *See* Liu, M.B., 4:39099
Krawczonek, W.M., *See* Singh, C.M., 4:39997
Krawczynski, S., *See* Gaertner, M., 4:38802
Krebs, L., Detection of local boiling in an LMFBR subassembly by temperature fluctuations analysis at the outlet, 4:38694
Kreid, D.K., *See* Quigley, M.S., 4:38256
Kreitzberg, C.W., Effects of mesosclae weather disturbances on contamination concentrations. Fifth technical progress report, 4:39530 (COO—2360-6)
Kretchman, K.W., *See* Speicher, H.W., 4:38043
Krickenberger, K., *See* Goldgraben, G.R., 4:39564
Krienen, F., Electron beam cooling: prospects of ribbon-type E-beams, 4:39478 (LBL—7574, pp 141-148)
Krinsky, S., Design status of the 2.5 GeV National Synchrotron Light Source x-ray ring, 4:39468 (BNL—25774)
Krisch, A.D., *See* Crabb, D.G., 4:39434
Kroeger, E., Performance of a thermionic converter module utilizing emitter and collector heat pipes, 4:38985 (N—78-27174)
Kroeger, G., *See* Wu, Y.C.L., 4:38956
Kroll, W., After -burner for flue gas from solid, liquid or gaseous materials, 4:39257
Kroodsma, R.L., Environmental Impacts Program, 4:38089 (ORNL—5508, pp 1-16)
Krueger, D.A., *See* Bader, B.E., 4:38145
Kruer, W.L., Laser-plasma coupling, 4:40015 (UCRL—81896)
Krug, W., GSB fuel element review meeting, 4:38677 (INIS-mf—4426, pp III.1-10)
Kruger, C.H., Spectroscopic measurements of temperature, electron density, and temperature fluctuations, 4:38965 (CONF-781009—, pp 731-747)
Krugh, T.R., *See* Auer, H.E., 4:39636
Kruglyi, S.I., *See* Gaponov, I.M., 4:38964
Kruse, U.E., *See* Kirk, T.B.W., 4:39825
Kryter, R.C., Loose-parts monitoring: present status of the technology, its implementation in U.S. reactors, and some recommendations for achieving improved performance, 4:38730
Kubagushev, N.G., Determination of stratal pressure with the aid of fluid additions, 4:38151
Kuenzel, H., Window as a solar collector, 4:38416 (AED-Conf—78-270-002)
Kugeler, K., *See* Niessen, H.F., 4:39143
Kugeler, M., *See* Niessen, H.F., 4:39143
Kuklinski, H.W., Waste energy recovery system, 4:38999
Kuleshov, G.D., *See* Abramyan, E.A., 4:39392, 4:39393
Kulidzhanov, Yu.Ya., *See* Gaziyants, A.P., 4:38173
Kumar, B., *See* Kestin, J., 4:38541
Kumazawa, R., *See* Watari, T., 4:39964
Kung, C.L., Converged values of second-order core-polarization diagrams with orthogonalized-plane-wave intermediate states, 4:39936
Kunin, Y.A., *See* Bashkin, A.S., 4:39317
Kunselman, R., *See* Rebka, G.A. Jr., 4:39829
Kuo, T.T.S., *See* Kung, C.L., 4:39936
Kupris, R., *See* Birmontas, A., 4:39307
Kupriyanov, N.L., *See* Bashkin, A.S., 4:39304, 4:39305
Kurtz, N., *See* Read, A.L., 4:39821
Kustom, R.L., *See* Ehsani, M., 4:39268
Kuswa, G.W., *See* Johnson, D.J., 4:39780
Kuvandykov, I.Sh., Study of hydrophobic acid emulsions, 4:38148
Kuzay, T.M., Analytic derivation of static pressure distribution in fully developed helical flows, 4:39328
Kuzmenko, P., Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry, 4:38980 (CONF-781009—, pp 775-800)
Kuznetsov, V.V., *See* Berzon, I.S., 4:39713
Kwan, T., Simulations of free electron laser, 4:39289 (LA-UR—79-675)
Kynaston, R.L., *See* Dyer, N.C., 4:38633

L

L'Heriteau, J.P., *See* Raymond, P., 4:38792

LaBauve, R.J., *See* Stewart, L., 4:39881
LaBounty, J.F., *See* Sartoris, J.J., 4:39632
Labrousse, M., Desalination applications of Thermos, 4:38711 (IAEA—206, pp 73-94)
LaChapelle, A.W., Codified and uncodified state laws and agency rules and regulations bearing on water and related land resources in Minnesota. Volume 1, 4:38919 (PB—284103)
Lacy, C.S., Decontamination experience at CANDU-PHW reactors, 4:38650
See Heathcock, R.E., 4:38648
LaFrance, L., *See* Gunaji, N.N., 4:38550
Lager, D.L., *See* Miller, E.K., 4:39962
Lahaie, G., *See* Grummitt, W.E., 4:38767
Lahey, R.T. Jr., Two-phase flow phenomena in nuclear reactor technology. Quarterly progress report No. 10, September—November 1978, 4:38818 (NUREG/CR—0702)
Lahiff, J.E., Engine exhaust gas recirculation system with periodic recalibration of exhaust back pressure reference, 4:39084
Lahmann, W., *See* Weitkamp, C., 4:39542
Lai, K.W., *See* Goddard, M.C., 4:39864
Lai, W., Modeling vertical loads in pools resulting from fluid injection, 4:38829
Lamaze, G.P., New measurement of the $^{6}Li(n,\alpha)T$ cross section, 4:39897
See Wasson, O.A., 4:39943
Lambert, J.D.B., *See* Strain, R.V., 4:38661
See Washburn, D.F., 4:38670
Lambert, J.E., *See* Agnew, L., 4:39450
See Grisham, D.L., 4:39451
Lambeth, J., Direct gain passive design: delap residence, 4:38433 (CONF-780337—P2, pp 4p, Book 2, Paper 2)
Lamboo, T.F., Gas discharge laser device, 4:39301
Lamont, W. Jr, Action handbook for small communities facing rapid growth 'case study' Scobey, Montana. Final report, 4:38869 (PB—285870)
Lampton, R.E., Solid waste handling and decontamination facility, 4:38249 (CONF-790331—4)
Landahl, C.C., Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey, 4:39614 (IVL-B—445)
Lander, G.H., *See* Smith, H.G., 4:39102
Lange, H., Process and device for controlling in situ combustion, 4:38152
Lange, R.A., *See* Bastin, J.J., 4:38228, 4:38229, 4:38230
Langstaff, D.C., *See* Washburn, D.F., 4:38670
Lanning, D.D., Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis, 4:38750 (NUREG/CR—0220)
Lansing, F.L., JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings, 4:38996 (N—78-31541)
Lantzke, U., Courage for a market economy energy policy, 4:39249
LaQue, F.L., Qualification of stainless steel for OTEC heat exchanger tubes, 4:38410 (ANL/OTEC—001)
Lari, R.J., *See* Foss, M.H., 4:39445
Larsen, R.P., Distribution of injected plutonium in the skeleton and certain soft tissues, 4:39688 (ANL—78-65(Pt.2), pp 145-153)
Method for the determination of ^{241}Am in urine, 4:39199 (ANL—78-65(Pt.2), pp 163-166)
Larson, B.C., *See* Appleton, B.R., 4:39196
Larson, D.C., *See* Hetrick, D.M., 4:39900
See Ueland, M., 4:38423
Larson, D.E., Conceptual design of a nuclear waste vitrification facility, 4:38255 (PNL—2690)
Larson, J.D., Thoughts on accelerator tubes, 4:39375 (LA—7445-C, pp 249-265)
Larson, R.E., *See* Cline, T.B., 4:38864
Lasar, S., Passive heated residences, 4:38436 (CONF-780337—P2, pp 4p, Book 2, Paper 5)
Lascu, D., *See* Lansing, F.L., 4:38996
Laska, R., Annotated bibliography of Interagency Energy/Environment R and D Program publications, 4:39527 (PB—284399)
Lau, T.K., *See* Powell, J.L., 4:38048
Laubacher, D., *See* Paciotti, M., 4:39453
Lauchlan, I.E.B., *See* Drolet, T.S., 4:38646
Laughlin, W., Proposed upgrading of an EN tandem for heavy ions, 4:39369 (LA—7445-C, pp 213-222)
Lauro, F., *See* Labrousse, M., 4:38711
Laursen, H.I., Response of a latticed transmission tower to wind. Final report, 4:38612 (PB—285123)
See Hess, B.W., 4:38613
Laursen, M., Corrections to the sixth-order anomalous magnetic moment of the muon, 4:39845
Lave, L.B., Environmental pollution and energy: an economic evaluation, 4:38874
Lavin, M.L., A life-cycle description of underground coal mining. Interim technical report, 4:38097 (N—78-28586)
Lawwill, T., Mechanisms of retinal damage from chronic laser radiation. Thresholds and mechanisms. Annual report, No. 4. 1 November 1976—31 October 1977, 4:39699 (AD-A—058449)
Lax, J.W., *See* Barale, J.J., 4:39457
Lazareth, O.W., *See* Tsang, J.S.K., 4:40005
Lazarus, D., *See* Weil, R., 4:39512
Le Gulllou, G., Boiling detection in fast reactors by noise analysis studies performed in France, 4:38695
Leadon, R.E., *See* Wilkenfeld, J.M., 4:39502
Leavens, J.M., *See* Wilson, E.M., 4:39047
Lebacqz, J.V., Trirotron, 4:39462 (SLAC-PUB—2266)
Lebedev, A.N., *See* Kolomensky, A.A., 4:39396
Lebens, R.M., Design tool to assess room air temperatures of a passively heated space, 4:38455 (CONF-780337—P3, pp 6p, Book 1, Paper 6)
Lebowitz, J.L., *See* Phani, M.K., 4:39949
Leckie, F.A., Approximate procedures in high temperature design, 4:38739
Ledbetter, J.O., *See* Thompson, W.T., 4:38261
Lederman, L.M., *See* Vidal, R., 4:39828
Lee, A.L., *See* Tran, D.Q., 4:38063
Lee, C., *See* Gidaspow, D., 4:38072
Lee, C.O., *See* Suratt, W.B., 4:38542
Lee, D.M., *See* Hsue, S.T., 4:38239
Lee, E.P., *See* Bangerter, R.O., 4:40016
Lee, H.N., Atmospheric turbulence and diffusion boundary layer transport model, 4:39528 (BNL—25026)
Lee, M.C., Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping, 4:38826 (UCB/EERC—79/08)
Lee, M.J., *See* Close, E., 4:39483
Lee, P.L., Development of a device for continuous automatic monitoring of consolidation of fresh concrete. Final report, 4:39497 (PB—285966)
Lee, S.S., General three-dimensional models for thermal pollution analysis, 4:39627
Lee, W.N., *See* Yeghiayan, R.P., 4:39524
Lee, Y.T., *See* Buss, R.J., 4:39794
Lee, Y.Y., *See* Weng, W.T., 4:39469
Leeds, M.W., A market survey of geothermal wellhead power generation systems. Final report, 4:38535 (N—78-27533)
Market survey of geothermal wellhead power generation systems. Final report, March 1978, 4:38528 (HCP/T1021—36)
Leeper, R.J., *See* Johnson, D.J., 4:39780
Lefevre, H.W., Progress in space charge lens development, 4:39423 (UCRL—81834)
Lefrois, R.T., Active heat exchange system development for latent heat thermal energy storage, 4:38836 (DOE/NASA/0038—79/1)
Leggett, R.D., Steady state irradiation behavior of mixed oxide fuel pins irradiated in EBR-II, 4:38672 (HEDL-SA—1683-FP)
Leising, C.J., Utilization of waste heat in trucks for increased fuel economy, 4:39053 (N—78-27532)
Leistritz, F.L., *See* Wieland, J.S., 4:38865
Lemaire, M.C., Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb $\rightarrow \pi^{+-}$, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A, 4:39887 (LBL—8463)
Lenders, H., *See* Baugnet, J.M., 4:38783
Leonard, F., *See* Baugnet, J.M., 4:38783
Leonard, T.M., User's manual for the compuer code PAREP, 4:38564 (SAND—79-0431)
Leontovich, A.M., *See* Kirkin, A.N., 4:39313
Lerouge, B., Thermos reactor, 4:38718 (TECHNICATOME-CONF—77-1)
Leskovar, B., *See* Zoellner, W.D., 4:39494
Lessen, M., *See* Lozansky, E.D., 4:39637
Lessor, D.L., Quantitative surface topography determination by Nomarski reflection microscopy I. Theory, 4:39514
LeSurf, J.E., Water chemistry of CANDU PHW reactors, 4:38651
Letournel, M., Belt charging system, characteristics, problems, structures, 4:39364 (LA—7445-C, pp 89-103)
Leventhal, J.J., Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978—May 31, 1979, 4:39791 (COO—2718-7)
Levin, D., Model design process for passive solar architecture, 4:38422 (CONF-780337—P1, pp 5p, Book 2, Paper 2)
Model design process for passive solar architecture, 4:38431 (CONF-780337—P2, pp 5p, Book 1, Paper 3)
Levin, S.A., *See* Blumkin, S., 4:38290
Levine, H., Higher-order instanton effects, 4:39876
Levine, P.J., *See* Leggett, R.D., 4:38672
Levine, R., Effective potential for heavy-quark—antiquark bound systems, 4:39839
Levy, S.C., Testing of a lithium battery for use in an earth penetrator, 4:38847 (SAND—78-1364)
Lewis, D.J., Application of computer methods to creep analysis, 4:38748
Lewis, N.H., Solar energy in agriculture, 1970—1977: 236 citations. Quick bibliography series, 4:38487 (NAL-BIBL—78-04)
Ley, W., Additional thermal cycling tests on solar cell panel samples under

vacuum conditions. Final report, 4:38389 (N—78-31585)
Leydig, R.L., *See* Carpenter, R.L., 4:39599
Lezhneva, A.V., *See* Perova, G.K., 4:38084
Libicki, J., Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB—284013)
Lichtenberg, D.B., Comment on a "New test of the synchronization procedure in noninertial systems", 4:39959
Lichtenstein, H., *See* Banks, N.E., 4:39522
Lichtman, M.A., *See* Moosavi, H., 4:39650
Lieb, D.P., *See* Kroeger, E., 4:38985
Liebe, R., Theoretical and experimental investigation of the nonlinear structural dynamics of Fast Breeder Reactor fuel elements, 4:38679 (KFK—2584)
Lieberman, B., *See* del Papa, C., 4:39816
Lieberman, M.L., Pyrotechnic output of TiH/sub x//$CKlO_4$ actuators. IV. Modelling of TiH/sub x//$KClO_4$ actuator pyrotechnic output, 4:39519 (SAND—79-0027)
Liebert, R., Principles of pulsing for tandem accelerators, 4:39431 (LA—7445-C, pp 113-123)
Lien, S., *See* Weaver, P., 4:38309
Liewers, P., *See* Grabner, A., 4:38637
Light, G.C., Experimental measurement of the rate of the reaction O(3p) + H2(v = 0) yields OH(v = 0) + H at T = 296°K. Interim report, 4:39218 (AD-A—059447)
Lightner, R.G., Capabilities and test program for the component development and integration facility and the coal fired flow facility, 4:38952 (CONF-781009—, pp 3-23)
Lileeva, J.J., *See* Malutchkov, O.T., 4:39147
Liljedahl, D.R., Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in Chicago, Illinois. Final report, 4:39027 (PB—284941)
Limpert, J.C., Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for the period ending December 31, 1977, 4:38237 (WCAP—9293)
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for period ending September 30, 1978, 4:38238 (WCAP—9422)
Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation, 4:38298 (WCAP—9345)
Lin, C.I., *See* Hollowell, C.G., 4:38995
Lin, E.I.H., *See* Sha, W.T., 4:38685
Lin, J., A study to conduct experiments concerning turbulent dispersion of oil slicks. Final report, October 1976—April 1978, 4:38162 (AD-A—058802)
Lin, K.H., Processes for immobilization of high-level solid wastes by glass and ceramic matrices, 4:38250 (CONF-790420—9)
Lin, W., *See* Hanson, M.E., 4:38181
Lindau, I., Photoemission study of Al/III-V interfaces, 4:39953
Lindestroem, L., *See* Landahl, C.C., 4:39614
Lindgren, R.A., *See* Ensslin, N., 4:39890
Lindquist, L.O., *See* Agnew, L., 4:39450
Lindsay, J., *See* Warren, R., 4:40009
Linhardt, H.D., Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, May 1—July 31, 1978, 4:38046 (ACD—38391-12)
Liniger, W., Perturbation calculation of the I-V characteristic of an extended Josephson junction, 4:39956
Link, J.M., The hydraulic transportation of oil shale. Research report, 4:38186 (PB—283817)
Linville, B., Contracts and grants for coopeative research on enhanced oil and gas recovery and improved drilling methods. Progress review No. 17, quarter ending December 31, 1978, 4:38137 (BETC—79/1)
Lior, N., *See* Agha, M.F., 4:38453
Lipkin, H.J., Quasinuclear colored quark model for hadrons, 4:39861 (FERMILAB-Conf—78/73-THY)
Lippek, H.E., Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL—2457)
Lippert, T.E., *See* Retallick, F.D., 4:38946
Liptrot, N.A., Tipping-vessel recording raingauge, 4:39548 (N—78-28761)
Liroff, S.D., Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final report, 4:38164 (PB—283719)
Lisitsyn, E.S., *See* Gryazev, V.M., 4:38682
Lissauer, D., *See* Gelfand, N., 4:39862
Lister, D.G., *See* Ball, S.J., 4:38819
Lister, D.H., Growth of radiation fields around CANDU boilers, 4:38652
Little, R., *See* Greenwald, A., 4:39385
Littma, M.S., Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL—78-65(Pt.2), pp 5-6)
Littman, F.E., Regional air pollution study: heat emission inventory. Final report, 4:39585 (PB—284081)
Liu, C.S., *See* Montgomery, D., 4:39988
Liu, C.T., *See* David, S.A., 4:39092
Liu, H., *See* Lin, J., 4:38162
Liu, J.S.K., *See* Collier, R.P., 4:38815
Liu, M., The development of a regional air pollution model and its application to the Northern Great Plains. Final report, 4:39568 (PB—285980)
Liu, M.B., Ion nitriding of titanium and zirconium by a dc-glow discharge method, 4:39099
Liubimov, G.A., *See* Antonov, B.M., 4:38977
See Bitiurin, V.A., 4:38955
Liubimov, V.D., *See* Gokhstein, Ya.P., 4:38978
Lloyd, E.L., Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship, 4:39675 (ANL—78-65(Pt.2), pp 9-19)
Suppression of transformed foci, induced by alpha radiation of C3H 10T1/2 cells, by untransformed cells, 4:39685 (ANL—78-65(Pt.2), pp 20-31)
Transformations of C3H 10T1/2 cells by Benzo(a)pyrene and subsequent attempts at suppression of transformed foci by untransformed cells and Vitamin A, 4:39686 (ANL—78-65(Pt.2), pp 32-42)
See Serio, C.S., 4:39676
Lobanov, A.N., *See* Basov, N.G., 4:39311
Lockner, T., Theoretical and experimental investigations of the autoaccelerator, 4:39388 (CONF-771035—P2, pp 585-600)
Loda, G.K., Recent advances in cold cathode technology as applied to high power lasers, 4:39287 (CONF-771035—P2, pp 879-890)
Loehoeiden, G., Levels in ^{160}Ho populated in the ^{166}Er(t(pol),α) reaction, 4:39913
Loehrke, R.I., *See* Sharp, M.K., 4:38504
Loew, G.A., Properties of a linac-storage ring stretcher system, 4:39482 (SLAC-PUB—2262)
Loferski, J.J., *See* Singh, R., 4:38395
Logan, B.G., *See* Baldwin, D.E., 4:40002
Logan, S.E., Status report on radioactive waste risk assessment methodology development supported by the U.S. Environmental Protection Agency, 4:38279
Lohman, G.M., A closed network queue model of underground coal mining production, failure, and repair, 4:38098 (N—78-30636)
Loiko, N.A., *See* Samson, A.M., 4:39319
Lomax, C.C., Studying the Northwest's low-head hydro potential, 4:38331
Lomenick, T.F., Burial ground technology, 4:39603 (ORNL—5508, pp 65-78)
Londergan, J.T., Isobars and the medium-energy (γ,p) reaction, 4:39888
Long, J. R., Federal R and D funding: modest gains in 1979, 4:38510
Long, W.F., Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978—December 31, 1978, 4:38619 (COO—5014-3)
Longley, W.L., Managing oil and gas activities in coastal environments, 4:38163 (PB—283677)
Longo, J.M., *See* Chang, C.H., 4:38856
Lonngren, K.E., *See* Farnsworth, A.V. Jr., 4:40017
Loomis, W.A., *See* Kirk, T.B.W., 4:39825
Loran, B.I., *See* O'Hara, J.B., 4:38051
Lord, R.S., *See* Ball, J.B., 4:39441
LoSecco, J., *See* Weng, W.T., 4:39429
Lotts, A.L., Sol-gel sphere-pac activities for the fuel refabrication and development program. Quarterly progress report for period ending December 31, 1977, 4:38227 (ORNL/TM—6746)
Loubsky, W.J., *See* Louis, J.F., 4:38948
Louie, S.G., Self-consistent mixed-basis approach to the electronic structure of solids, 4:39159
Louis, J.F., Combustion gas disk generator studies, 4:38948 (CONF-781009—, pp 383-410)
Love, C.C., Fort St. Vrain Surveillance Program: Transient Analysis Program (TAP) verification, 4:38639 (GA-A—15159)
Lowe, A.T., Magnetron sputter coating of microspherical substrates, 4:40018
Lowell, C.E., *See* Zellars, G.R., 4:38126
Lowenbach, W., Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB—285072)
Lowenstein, D., *See* Allinger, J., 4:39436
Lozansky, E.D., Does DNA have two structures in solution that coexist at equilibrium, 4:39637 (UR—3490-1569)
Lu, A., *See* Caldwell, D.O., 4:39817
Lu, S.C., Effects of torus wall flexibility on forces in the Mark I boiling water reactor pressure suppression system. Final report, 4:38821 (NUREG/CR—0746)
Lu, S.C.H., *See* Ma, S.M., 4:38634
Lucas, H.F. Jr., *See* Rowland, R.E., 4:39673
See Stehney, A.F., 4:39674
Lucas, W.J., The Department of Defense's alternate energy policy. Final report, 4:38915 (AD-A—058200)
Ludwig, G.O., High frequency stability of field-reversed ion rings in a background plasma, 4:39987 (N—78-28941)
Luenberger, D.G., *See* Cline, T.B., 4:38864
Luke, K.W., *See* Holcombe, L.J., 4:38606
Lumpkin, A.H., Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ ≅ 14.3 and 25.2 MeV, 4:39891

Lumsdaine, E., Lumsdaine solar house, 4:38440 (CONF-780337—P2, pp 2p, Book 2, Paper 10)
Lumsdaine, M., *See* Lumsdaine, E., 4:38440
Lund, T.S., Operating experience with an 834 Hiconex sputter ion source, 4:39427 (LA—7445-C, pp 175-186)
Lunsford, J.H., Reactive intermediates in catalytic methanation, 4:38313 (LBL—8975, pp 15.-17.)
Lupton, W.H., *See* Vitkovitsky, I.M., 4:39440
Luste, G.J., *See* Caldwell, D.O., 4:39817
Luykx, F., Radioactive effluent discharges. Intercomparability of data, 4:38771
Luzyanin, G.S., Study of boreholes by the use of a seam tester on tubes with surface gas emission, 4:38154
Lynch, F.J., *See* Holland, R.E., 4:39894
Lynch, J.J., *See* Cutting, J.C., 4:38947
Lyon, W.S., Radioanalytical chemistry in the USA. Continuing a tradition of excellence, 4:39205
See Eldridge, J.S., 4:38761
Lysenko, W.P., Linac particle tracing simulations, 4:39404 (LA-UR—79-709)
Lytle, R.J., Alternative methods for determining the electrical conductivity of core samples, 4:39709
Lyubchenko, V.F., *See* Mitel'man, M.G., 4:39491

M

Ma, E., Asymptotic freedom without guilt, 4:39872 (UH—511-329-79)
Ma, S.M., Review of tube support plate analysis for steam generators of Millstone Unit II Nuclear Power Plant, 4:38634 (UCID—17958)
MacCracken, M.C., MAP3S programs applicable to PEPE's, 4:39573 (UCRL—82549)
Macek, R.J., LAMPF primary beam line protection system, 4:39406 (LA-UR—79-750)
Macfarlane, B.J., *See* Darley, P.J., 4:38645
Machiels, A.J., Molecular beam study of the kinetics of the fluorine—uranium dioxide reaction, 4:39782
MacKay, W.W., *See* Kirk, T.B.W., 4:39825
Mackewicz, W.V., *See* McCone, A.I., 4:38566
MacLeod, E.N., Evaluation and optimization of solid polymer electrolyte (SPE) fuel cells. Final technical report, 23 May 1977-23 April 1978, 4:38987 (AD-A—058380)
Macleod, I.D., Acoustic detection of boiling in LMFBRs: an estimate of sensitivity derived from experiments during the commissioning of PFR, 4:38696
MacPherson, R.E., *See* Gnadt, P.A., 4:38687
Madden, H.H., AES investigation of the chemical structure of silicon oxy-nitride films, 4:39233
See Zehner, D.M., 4:39153
Madland, D.G., Calculation of prompt fission neutron spectra, 4:39917 (LA—7722-PR, pp 11-13)
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV, 4:39922 (LA-UR—78-3062)
See Mann, F., 4:39921
Madsen, S.K., *See* Taasevigen, D.K., 4:39706
Maeland, A.J., *See* Bowman, R.C. Jr., 4:39176
Maene, N., *See* Debrue, J., 4:38722
Magee, C.W., *See* Wampler, W.R., 4:40006
Maguire, C.F., Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39, 4:39902 (INIS-mf—4427, pp 44)
Mahajan, S.M., *See* Strauss, H.R., 4:39991
Mahoney, F.G., Hot fuel gas generator, 4:39058
Mahoney, J., *See* Gelbke, C.K., 4:39915
Mainland, G.B., *See* Kitazoe, T., 4:39869
Makenas, B., *See* Brun, T.O., 4:39174
Makenas, B.J., *See* Kajitani, T., 4:39175
Maksimenko, V.I., *See* Sheindlin, A.E., 4:38953
Maksimov, V.P., *See* Akhmetshina, I.Z., 4:38157
Maksutov, R.A., *See* Yusupov, I.G., 4:38146
Malaviya, B.K., *See* Bokharee, S.A., 4:39444
Malkiewicz, J., *See* Halawa, T., 4:38615
Mallon, C.E., *See* Wilkenfeld, J.M., 4:39502
Malloy, R.W., *See* Siems, P.L., 4:38206
Maloszewski, J., Present state and directions of progress in mechanization of development work, 4:38109
Malutchkov, O.T., Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM—2600(TR))
Mamontov, A.M., Characteristics of radiation damage of silver-doped p-type germanium, 4:39164
Radiation damage profile of compensated p-type germanium irradiated with fast electrons, 4:39163
Manaka, N., *See* Asano, M., 4:39060
Manchester, D.F., Development of an Air Force Facilities Energy Information System. Master's thesis, 4:38991 (AD-A—059309)
Manheimer, W.M., Theory of electron energy confinement in tokamaks, 4:39968
Mankiewicz, P., *See* Anderson, O.L., 4:38121
Mann, A.K., Recent results on neutrino reactions, 4:39820 (COO—3071-237)
Mann, B.J., *See* Pigford, T.H., 4:38599
Mann, F., Summary documentation for ^{242}Pu, 4:39921 (LA—7663-MS, pp 125-132)
Manny, E.F., *See* Gilkey, A.D., 4:39664
Mansoori, F.S., *See* Edalat, M., 4:38706
Mantzouranis, G., *See* Moretto, L.G., 4:39928
Marchant, D.D., Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL—2738)
Marco, J., *See* Paillous, A., 4:39184
Mardesich, N., *See* Taylor, W.E., 4:38372, 4:38373
Margetts, M.J., Chalk Point Cooling Tower Project. Volume I, phase V. Analysis and archiving program, FY77. Final report, 1 July 1976—31 August 1977, 4:39556 (PB—284826)
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976—31 August 1977, 4:39557 (PB—284827)
Margler, L.W., *See* Anderson, O.L., 4:38121
Mariani, E.O., Eucalyptus Energy Farms as a renewable source of fuel, 4:38401
Marine, I.W., Determination of the location and connectivity of fractures in metamorphic rock with in-hole tracers, 4:39707 (DP-MS—79-11)
Marinin, N.S., *See* Akhmetshina, I.Z., 4:38157
Markant, H.P., *See* Dicks, J.B., 4:38950
See Dicks, J.B. Jr., 4:38957
Markind, J., Study of reverse osmosis applicability to light water reactor radwaste processing, 4:38253 (NUREG/CR—0724)
Markun, F., *See* Holtzman, R.B., 4:39256
See Rundo, J., 4:39578, 4:39579
Markuszewski, R., *See* Wheelock, T.D., 4:38044
Marple, V.A., Dynamic particle size measurement of coal dust. Final report, 1 October 1973—30 November 1976, 4:38102 (PB—285096)
Marques, E., Social and economic impact of nuclear energy in Brazil. A structural analysis with a generalized input-output model, 4:38894 (INIS-mf—4521)
Marshall, T.C., Millimeter wave generation through stimulated scattering with an intense relativistic electron beam and a controlled zero-frequency pump, 4:39335 (CONF-771035—P2, pp 697-702)
Marshall, W.F., Performance characteristics of automotive engines in the United States. First series - Report No. 14. 1975 Mazda rotary 70 CID (1.1 liters), 4v. Interim report, July 1977, 4:38983 (PB—286074)
See Chamberlain, T.W., 4:39065, 4:39066
See Koehler, D.E., 4:39067
Martell, E.A., Radioactive emanations and the formation and composition of aerosols, 4:39584
Martella, L.L., *See* Navratil, J.D., 4:38241
Martin, D., *See* Goldgraben, G.R., 4:39564
Martin, F., Results on nucleon structure functions in quantum chromodynamics, 4:39873
Martin, F.J., Gas turbine construction and combustion process carried out in gas turbine, 4:38589
Martin, J.A., *See* Ball, J.B., 4:39441
Martin, J.F., *See* Caldwell, D.O., 4:39817
Martin, J.J., Monitoring of gaseous and liquid effluent releases at French nuclear power stations, 4:38772
Martinez-Baez, L.F., Thermal properties of Gable Mountain basalt cores, Hanford Nuclear Reservation, 4:39725 (LBL—7038)
Martini, M., Progress report on detector cross section benchmark measurements in the TAPIRO reactor, 4:39488 (IAEA—208(Vol.2), pp 321-326)
Maruvada, S.N., *See* Cutting, J.C., 4:38947
Maschke, A.W., *See* Gammel, G.M., 4:39380
See Haber, I., 4:39770
Maskarinec, M.P., Practical aspects of glass capillary gas chromatography, 4:39214 (CONF-790330—1)
Maslennikov, G.I., *See* Bitiurin, V.A., 4:38955
Maslennikov, V.M., Combustion chambers for MHD power plants, 4:38960 (CONF-781009—, pp 439-470)
See Sheindlin, A.E., 4:38945
Mason, B., Solar energy commercialization and the labor market, 4:38367 (SERI/TP—53-123)
Massey, M.J., *See* Dunlap, R.W., 4:38059
See Pochan, M.J., 4:38060
Massoth, F.E., Characterization of CO + H_2 catalysts for production of light hydrocarbons, 4:38315 (LBL—8975, pp 34.)
Diffusion of polyaromatics in catalyst supports, 4:39240 (LBL—8975, pp 33.)
Mastrup, F.N., Optical resonance pumped transfer laser with high multiline photon-to-single-line photon conversion efficiency, 4:39298
Mather, J.D., *See* Hill, M.D., 4:38278
Mathews, G.J., *See* Moyle, R.A., 4:39895

Mathur, A.K., *See* Lefrois, R.T., 4:38836
Matis, H.S., *See* Bowman, J.D., 4:39818
Matsonashvili, B.N., *See* Gureev, D.M., 4:39309
Matsumoto, S., Method of recording radiographic images, 4:39329
Matsunaga, T., Thermal properties of rocks and heat extraction from hot dry rocks. I, 4:38553
Matteson, M.J., Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977—November 30, 1978, 4:39551 (ORO—5592-2)
Matthews, J.H., *See* Kirkham, D.O., 4:39033
Matula, R.A., Combustion kinetics of selected aromatic hydrocarbons. Interim report 1 Jun 77-13 May 78, 4:38174 (AD-A—059381)
Matusevich, A.V., Nature of local gravitational anomalies in northern Ustyurt, 4:39722
Matveev, V.A., Quark analysis of multibaryonic systems, 4:39857
Mau, T.K., *See* Scharer, J.E., 4:39966
Maulucci, R.A., *See* Hegner, S.J., 4:40044
Mausner, L.F., Analysis of thick source alpha particle spectrum from radium and its daughters in bone, 4:39678 (ANL—78-65(Pt.2), pp 80-94)
Maxsted, M.D., *See* Dixon, R.L., 4:39280
Maxwell, B., *See* Collins, C.J., 4:38071
Maxwell, J.C., Geothermal exploration methods and results: inland states, 4:38519 (LA-UR—79-665)
May, H.A., *See* Toohey, R.E., 4:39681
May, M., (K,π) reaction at Brookhaven, 4:39822 (BNL—25879)
Maybee, S., Time series forecasting of utility load duration curves, 4:38933
Mayo, S.F., *See* Glaros, S.S., 4:40021
Mazria, E., Noti solar greenhouse, performance and evaluation, 4:38445 (CONF-780337—P2, pp 7p, Book 3, Paper 1)
Mazur, N.I., *See* Bystry, A.I., 4:38979
Mazur, P.O., Adjustable expandable cryogenic piston and ring, 4:39274
McBrayer, J.F., *See* Franco, P.J., 4:39595
McCain, J.D., CEA variable-throat venturi scrubber evaluation. Final report, May 1977—December 1977, 4:38604 (PB—285723)
McCaleb, K.E., *See* Brown, S.L., 4:39553
McCann, K.J., Theoretical cross sections for ionization of metastable excimers Ne^*_2 and Ar^*_2 by electron impact, 4:39797
Mccarthy, J.F., *See* Gull, G.E., 4:39733
McCauley, E.W., *See* Lai, W., 4:38829
See Lu, S.C., 4:38821
McClaine, A., *See* Cole, J., 4:38975
McCleary, P., *See* Agha, M.F., 4:38453
McCone, A.I., Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1, 4:38566 (AD-A—057405)
McCormick, C.L., Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977—September 1978, 4:39235 (BETC—5603-5)
See Wildman, G.C., 4:39236
McCormick, J.B., Development of integrated thermionic circuits for geothermal high-temperature applications, 4:38525 (LA-UR—79-723)
McCracken, G.M., *See* Wampler, W.R., 4:40006
McCulloch, R.W., *See* Gnadt, P.A., 4:38687
McCutchan, D.A., *See* Retallick, F.D., 4:38946
McDaniel, F.D., *See* Mehta, R., 4:39779
McDaniel, P.J., *See* Farnsworth, A.V. Jr., 4:40017
McDonnell, F.N., Spatial power control in large CANDU reactors: the whys and wherefores, 4:38751 (AECL—6212)
McDowell, W.P., Stepping motor translator, 4:39344
McElherne, P.F., *See* O'Hara, J.B., 4:38051
McElroy, J.F., *See* MacLeod, E.N., 4:38987
McEnerney, J.W., Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM—6609)
McFadden, J.H., Energy supply and environmental impacts conventional sources, study module III-A. Technical Appendix. Code users manual (final), 4:39634 (PB—283787)
McGoldrick, P.R., *See* Anderson, R.E., 4:39974
McInturff, A.D., Design, construction, and operation update of the ISABELLE ring magnets, 4:39473 (BNL—25822)
McIntyre, P., Accommodating stochastic cooling at Fermilab, 4:39416 (LBL—7574, pp 149)
See Cline, D., 4:39422
McIssac, C.V., *See* Dyer, N.C., 4:38633
McKay, J., Carbon-14 dating using a tandem, 4:39368 (LA—7445-C, pp 203-211)
McKeown, M., Brookhaven terminal ion source, 4:39428 (LA—7445-C, pp 187-198)
McKibben, J.L., Experience with accelerating tubes, 4:39376 (LA—7445-C, pp 266-276)
McKillop, D.C. Sr., Building heating system, 4:38997
McLean, A.F., Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977—March 1978, 4:39073 (AMMRC-TR—79-11)
McMenamin, J.C., *See* Bauer, R.S., 4:39189
McMillan, B.G., *See* Buttermore, W., 4:38118
McNaught, R., Telemetry systems: a review and a forecast, 4:39362 (LA—7445-C, pp 41-59)
McNaughton, M.W., *See* Anderson, B.D., 4:39906
McNeany, S.R., *See* Allen, E.J., 4:38226
McNeill, D.W., *See* Murakami, M., 4:39970
McNeilly, G.S., *See* Ball, J.B., 4:39441
McNulty, P.J., Visual phenomena induced by relativistic carbon ions with and without Cerenkov radiation, 4:39666
McPharlin, T., *See* Bowman, J.D., 4:39818
Meats, R.J., *See* Hampton, B.F., 4:38611
Mech, S.J., *See* Fields, S.R., 4:39277
Mecuro, N., *See* Edens, T.C., 4:38877
Medin, S.A., *See* Bitiurin, V.A., 4:38955
Meger, R.A., Beam trapping experiments on the University of Maryland Electron Ring Accelerator, 4:39389 (CONF-771035—P2, pp 601-612)
Mehner, A.W., *See* Pott, G, 4:38640
Mehta, R., K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4—3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
Meier, J.G., *See* Baumgartner, H., 4:39349
Melhuish, K.R., Water chemistry in the Dounreay prototype fast reactor (PFR) power station, 4:38690
Melius, C.F., *See* Upton, T.H., 4:39151
Melnick, G., Observations of the 51.8 micron (O III) emission line in Orion, 4:39732 (N—78-28024)
Melzer, B., *See* Starr, G., 4:38434
Menil, R., *See* Debrue, J., 4:38722
Menju, S., *See* Murakami, Y., 4:38618
Menon, M.M., *See* Stirling, W.L., 4:40011
Mercer, A.G., Very-low-head hydroelectric generation, 4:38338
Mermaz, M.C., *See* Gelbke, C.K., 4:39915
Meservey, E., *See* Bitter, M., 4:39973
Meservey, E.B., *See* Dylla, H.F., 4:40024
Meskhy, G.O., *See* Kolomensky, A.A., 4:39387
Messier, R.F., *See* Tsong, I.S.T., 4:39213
Mesyats, G.A., *See* Baksht, R.B., 4:39394
Metcalfe, L., *See* Sherman, P.L., 4:39571
Meyer, C.H. Jr., H^+ and D^+ sputtering of thin tantalum films in the energy range of 0.6 to 15 keV, 4:39148
Meyer, H.S., *See* Painter, M.J., 4:38262
Meyer, J.H., Chalk Point cooling tower project: chalk point surface weather and ambient atmospheric profile data, September—December 1975, 4:39586 (PB—284211)
Chalk Point cooling tower project: Chalk Point surface weather and ambient atmospheric profile data; second intensive test period, June 14-24, 1976, 4:39587 (PB—284213)
Meyer, R.A., Multigamma-ray calibration sources, 4:39942 (M—100)
Meyer, R.E., *See* Grisham, D.L., 4:39451
Meyer, W.G., *See* Dyer, P., 4:39925
Meyer-Renschhausen, M., *See* Pfaffenberger, W., 4:38898
Meyer-Schuetzmeister, L., *See* Holland, R.E., 4:39894
Meyers, S.C., *See* Chan, A.I.Y., 4:38780
Michael, P., Comparison of particulate and gaseous material within and above the mixed layer, 4:39540 (BNL—25002)
Michaelis, W., *See* Weitkamp, C., 4:39542
Middleton, G.J., Energy analysis of zinc production, 4:39034 (PB—283951)
Middleton, R., Effects of the Coulomb explosion on the transmission of molecular ions through a tandem, 4:39771 (LA—7445-C, pp 15-30)
Synopsis of tritium running at Penn, 4:39367 (LA—7445-C, pp 199-201)
Mignerey, A., *See* Dyer, P., 4:39925
Mihalczo, J.T., *See* Murakami, M., 4:39970
Mihalov, J.D., Pioneer 10 observation of the solar wind proton temperature heliocentric gradient, 4:39748 (N—78-31030)
Mikaelian, K.O., Charmed-baryon production in electron-positron annihilation, 4:39844
Mikhailov, Yu.S., *See* Gaponov, I.M., 4:38964
Mikhan, V.I., *See* Korsakov, V.S., 4:38623
Mikulski, A.T., Some recent developments in reactor noise analysis at Swierk, 4:38638
Milburn, R.H., *See* Kirk, T.B.W., 4:39825
Miles, R.O., Characteristics of a distributed feedback carbon dioxide laser, 4:39324
Millar, R.A., *See* Vigneron, F.R., 4:38396
Miller, C.G., *See* Kenkeremath, D.C., 4:39562
Miller, D.E., *See* Armantrout, G.A., 4:38394
Miller, E.K., Inversion of one-dimensional scattering data using Prony's method, 4:39962 (UCRL—52667)
Miller, F.C., *See* Joo, L.A., 4:38854
Miller, G.D., *See* Zanotelli, W.A., 4:38820
Miller, L.L., *See* Owens, M.R., 4:39638
Miller, P.D., *See* Knudsen, H., 4:39940
See Mehta, R., 4:39779
See Moak, C.D., 4:39170
Miller, R.H., *See* Prescott, C.Y., 4:39870
Miller, R.K., *See* Molton, P.M., 4:38319
Miller, R.L., *See* Moses, R.W., 4:40001
Millich, A., *See* Allen, M.A., 4:39484
Millman, L.L., *See* Hymowitz, E.W., 4:38474
Mills, F., *See* Cline, D., 4:39422
Mills, F.S., An experimental/analytical program to assess the utility of lidar for pollution monitoring. Final report,

1 September 1976—31 October 1977, 4:39546 (N—78-27614)
Mills, K.A., *See* Perfetti, P., 4:39954
Millsap, D.A., *See* Rogers, J.W., 4:38779
Milner, R., Buncher development for ORIC injection, 4:39425 (LA—7445-C, pp 124-137)
Milner, W.T., *See* Ball, J.B., 4:39441
Minakawa, S., *See* Shida, I., 4:38522
Miner, J., *See* Boersma, L., 4:38318
Miniaev, N.A., *See* Maslennikov, V.M., 4:38960
Minogue, R.W., Low energy sign illumination system, 4:39036
Minohara, Y., *See* Seikieka, M., 4:38549
Miranda, J.E. Jr., *See* Holtzman, R.B., 4:39256
Miribel, J., Determination of contamination in the air of reactor containment. Sampling and measuring techniques, 4:38738
Mirzagaliev, M.Z., *See* Gabdrakhmanov, A.G., 4:38156
Misakov, P.Y., *See* Burakov, V.S., 4:39975
Mischke, R.E., *See* Bowman, J.D., 4:39818
See Frank, J.S., 4:39832
Misfeldt, I., FFRS: A computer program for the thermal and mechanical analysis of fuel rods, 4:38627 (RISO—373)
Mishin, G.T., Determining the water-insoluble residue in potassium salts by gamma surveying, 4:38204
Miskolczy, G., *See* Kroeger, E., 4:38985
Mitchel, R.E.J., *See* Birnboim, H.C., 4:39646
Mitchell, A.B., *See* Lacy, C.S., 4:38650
Mitchell, V.E., *See* Siems, P.L., 4:38206
Mitel'man, M.G., Detectors for in-reactor measurement of energy release, 4:39491
Mitsui, A., Solar energy conversion to hydrogen by algae and bacteria, 4:38308 (CONF-780161—1)
Mitzel, F., Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation, 4:38680 (KFK—2619)
See Hoppe, P., 4:38693
Miyahira, T.F., *See* Downing, R.G., 4:38387
Miyasaka, T., *See* Mizuta, Y., 4:38523
Miyazaki, N., Creep analysis in structures. Finite element creep buckling analysis of shallow spherical shells, 4:38745 (UTNL-R—0046, pp 18-22)
Mizukami, S., *See* Kohama, H., 4:39355
Mizuta, Y., Pre-calculation of the temperature of air currents in a tunnel designed to excavate in the rock mass at high temperature, 4:38523
Moak, C.D., Absolute charge state yields of 20 MeV ^{127}I ions emerging from a gas stripper, 4:39792 (LA—7445-C, pp 3-13)
Resonant coherent excitation of channeled ions, 4:39170
See Knudsen, H., 4:39940
Mobley, R.M., *See* Gammel, G.M., 4:39380
Mocas, V.A., Battery container having cast battery terminal formed therein, 4:38857
Mohanakrishnan, P., Reactivity prediction of uniform PuO_2—UO_2-fueled lattices and $Pu(NO_3)_4$ solutions in light water, 4:38727
Mohler, G.E., *See* Buzzard, R.J., 4:39302
Mohtadi, M.M., *See* Earley, R.F., 4:38360
Moioli, P., *See* Martini, M., 4:39488
Molenkamp, C.R., Introduction to self-induced rainout, 4:39582 (UCRL—52669)
Mollaev, R.Kh., *See* Tosunov, E.M., 4:38149
Molotova, N.A., *See* Gomzikov, V.K., 4:38155
Molton, P.M., Mechanism of conversion of cellulosic wastes to liquid fuels in alkaline solution, 4:38319
Molvig, K., *See* Hirshman, S.P., 4:39995
Momotov, Yu.M., *See* Antonov, B.M., 4:38977
Monaghan, D.A., *See* Wallhagen, R.E., 4:38104
Monahan, J.E., *See* Holland, R.E., 4:39894
Monsay, E., *See* Babcock, J., 4:39867
See Hidaka, K., 4:39868
Monsler, M.J., *See* Bangerter, R.O., 4:40016
Montan, D.N., *See* Hanson, M.E., 4:38181
Montgomery, D., Nonlinear development of an electromagnetic filamentation instability, 4:39988
Month, M., *See* Courant, E.D., 4:39470
Montwill, A., *See* Read, A.L., 4:39821
Moody, G.W., Device for deriving power from wave energy, 4:38560
Moody, H.L., Multi-ray ablation sensor development program. Final report, 2 June 1975—15 December 1976, 4:39496 (AD-A—058366)
Moon, D.M., *See* Bamford, W.H., 4:38631
Moons, F., *See* Pott, G, 4:38640
Moore, J.G., Radioactive waste fixation in FUETAP (formed under elevated temperature and pressure) concretes-experimental program and initial results, 4:38254 (ORNL/TM—6573)
Moore, R., UHV compatibility of two possible fusion reactor materials: K-ramic/sup R/ and ATJ graphite, 4:40023
Mooring, F.P., *See* Holland, R.E., 4:39894
Moosavi, H., Improved histochemical methods for the examination of plastic-embedded human marrow, 4:39650 (UR—3490-1553)
Moravek, J., Experience of measuring radioactive iodine by the cumulative method in gaseous discharges from nuclear power stations, 4:38737
More, J.J., Implementation and testing of optimization software, 4:40034 (DOE/TIC—10096)
More, R.M., Quantum-statistical model for high-density matter, 4:39155
Moretto, L.G., Angular momentum transfer in deep inelastic scattering. Experimental evidence and a model based upon particle transfer, 4:39933 (INIS-mf—4427, pp 27)
Dynamical birth and thermal death of angular momentum in heavy ion reactions, 4:39914 (LBL—8613)
Giant E1 mode and its energy broadening from the charge distributions in heavy-ion reactions, 4:39928
Role of deep inelastic processes in nuclear physics: experimental aspects of deep inelastic reactions, 4:39834 (LBL—8936)
Morishita, M., *See* Hibino, M., 4:39055
Morley, L.A., Materials suitable for use inside explosion-proof enclosures. Final report, 7 September 1975—7 March 1976, 4:38131 (PB—283972)
Morozov, G.N., *See* Bitiurin, V.A., 4:38955
See Sheindlin, A.E., 4:38945
Morris, J., *See* Graf, G.L., 4:38194
See Kroeger, E., 4:38985
Morris, R.E., *See* Brewer, G.D., 4:39017, 4:39018
Morris, W.H.D., Heating appliances, 4:38998
Morrison, R.J., *See* Caldwell, D.O., 4:39817
Morse, M.D., Rotational distributions from photodissociations. I. Linear triatomic molecules, 4:39768
Rotational distributions from photodissociation. II. Results for $ICN+h\nu \rightarrow I+CN(X\ ^2\Sigma^+)$, 4:39769
Moser, R.E., Straflo turbine, 4:38334
Moses, R.W., Conceptual design of the Fast-Liner Reactor (FLR) for fusion power, 4:40001 (LA—7686-MS)
Moskal, E.J., High flow, high temperature magnetic filtration of the primary heat transport coolant of the CANDU power reactors, 4:38653
Mosko, S.W., *See* Ball, J.B., 4:39441
Moss, L., *See* del Papa, C., 4:39816
Mostrom, M.A., Raman side-scatter instability in nonuniform plasma, 4:39994
Mote, C.D. Jr., *See* Eason, E.D., 4:40045
Mott, J.E., Diagnosis of subharmonic vibrations in rotating machinery, 4:38729
Motz, D., *See* Taliaferro, R.C., 4:38103
Moussa, P., *See* Baker, G.A. Jr., 4:39947
Moyle, R.A., Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50—90 MeV, 4:39895
Mozharovskii, A.M., *See* Kirkin, A.N., 4:39313
Mozley, R., *See* del Papa, C., 4:39816
Muehlhauser, J.W., *See* Wu, Y.C.L., 4:38956
Mueller, A., Safety analyses for high-temperature reactors, 4:38789 (AED-Conf—78-023-004)
Mueller, B., *See* Franzen, L.F., 4:38764
Mueller, M.H., *See* Brun, T.O., 4:39174
See Faber, J. Jr., 4:39173
See Kajitani, T., 4:39175
Mueller, R.O., *See* Asbury, J.G., 4:39003
Muenchow, W., *See* Albrecht, L., 4:38828
Muhs, A.G., *See* Kostuk, R.K., 4:39649
Mukherjee, A.K., *See* Bunch, R., 4:39103
Mulchi, C.L., Chalk point cooling tower project: cooling tower effects on crops and soils. preoperational report. Report for April 1973—April 1975, 4:38593 (PB—284075)
Chalk point cooling tower project: cooling tower effects on crops and soils. Preoperational report, appendix. Report for April 1973—April 1975, 4:38594 (PB—284076)
Chalk point cooling tower project: cooling tower effects on crops and soils. Postoperational report No. 1, Volume 1. Final report, May 1975—April 1976, 4:38595 (PB—284077)
Chalk point cooling tower project: cooling tower effects on crops and soils. postoperational report no. 1, volume 2. Final report May 1975-April 1976, 4:38596 (PB—284078)
Chalk point cooling tower project: cooling tower effects on crops and soils. post operational report no. 2. Final report FY 1977, 4:38597 (PB—284094)
Mulder, M.C., Microprocessor oriented data acquisition and control system for power system control, 4:38617
Mulhearn, P.J., *See* Sheih, C.M., 4:39511
Mulik, J.D., Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB—284938)
Mullin, M.M., *See* Star, J.L., 4:39610
Mulliner, D.K., *See* Bischoff, W.S., 4:38540, 4:38543
Murakami, H., *See* Sugimura, H., 4:38079
Murakami, M., Plasma confinement studies in the ISX-A tokamak, 4:39970
Murakami, Y., Fundamental techniques for gas-insulated apparatus, 4:38618
Murch, G.E., Drift mobility correlation in a simple cubic lattice, 4:39105
Murdock, S.H., *See* Wieland, J.S., 4:38865
Murphy, F.V., *See* Caldwell, D.O., 4:39817
Murray, J.A., *See* Lamont, W. Jr, 4:38869
Murray, R.G., Improved engine performance through heat transfer

control. Final report, 1 June 1976—30 June 1978, 4:38990 (AD-A—058637)
Murtagh, M.J., *See* Cnops, A.M., 4:39819
Mushotzky, R.F., X-ray observations of a flare in NGC4151 from OSO-8, 4:39739 (N—78-31021)
X-ray observations of BL Lac objects, 4:39741 (N—78-32016)
Muslimov, R.Kh., Substantiation of the technological principles for working bituminous fields of Tataria, 4:38198
Muth, M.C., *See* Dakin, J.T., 4:38586
My, T., *See* Wu, Y.C.L., 4:38956
Myal, D., Bell Creek residual oil saturation technology test. Project quarterly report for period October 1978—December 1978, 4:38140 (BETC—2180-4)
Myer, L.R., *See* Byrne, R.J., 4:38267
Myklebust, R.L., *See* Pella, P.A., 4:39212

N

Nablo, S.V., Performance characteristics of large area electron accelerators, 4:39397 (CONF-771035—P2, pp 833-844)
Nachtigall, A.J., *See* Halford, G.R., 4:39136
Naes, L.G., Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N—78-30656)
Nagamiya, S., *See* Lemaire, M.C., 4:39887
Nagao, H., *See* Iimura, H., 4:38735
Nagesh, V.K., Method for preparing a thick film conductor, 4:39342
Nagle, D.E., Physics uses of intense proton beams at 10 to 20 GeV, 4:39454 (LA-UR—79-898)
See Bowman, J.D., 4:39818
See Frank, J.S., 4:39832
Nahavandi, A.N., Review on fluid forces on circular cylinders in cross flow, 4:38662 (ANL-CT—79-16)
Nair, S., User's guide to the reactor inventory code RICE, 4:38725 (RD-B-N—4079)
Nairn, J.A., *See* Pearlstein, R.M., 4:39243
Nandi, S., *See* Aubrecht, G.J. II, 4:39851
Nandi, S.P., *See* Tran, D.Q., 4:38063
Nandwani, T.B., Monitoring of radioactive waste discharges from Tarapur Atomic Power Station (TAPS), 4:38773
Naoe, M., *See* Seikieka, M., 4:38549
Napolitano, L.G., Space and energy, 4:38354
Narasimhan, T.N., Finite element method for subsurface hydrology using a mixed explicit-implicit scheme, 4:39708
Results of reservoir engineering tests, 1977, East Mesa, California, 4:38546 (LBL—7091)
Narayan, J., *See* Appleton, B.R., 4:39196
Narayanan, P., *See* Davidoff, P., 4:38359
Nash, G.J.C., Decontamination of the SGHWR prototype, 4:38654
Nash, T., *See* Caldwell, D.O., 4:39817
Nasibov, A.S., *See* Kozlovskii, V.I., 4:39308
Nasser, M.A., *See* Stetz, A., 4:39847
Nasyrova, R.G., *See* Kuvandykov, I.Sh., 4:38148
Nation, J.A., High power electron and ion beam research and technology, 4:39439 (CONF-771035—P2)
See Adler, R., 4:39382
Naumenkov, P.A., *See* Burakov, V.S., 4:39975
Naus, D.J., Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems, 4:38642 (ORNL/TM—6478)
Navickis, L.L., *See* Wing, R.E., 4:39351
Navratil, J.D., Americium recovery and purification at Rocky Flats, 4:38241 (RFP—2886)
Nazarova, E.P., *See* Kuvandykov, I.Sh., 4:38148
Nazirov, N.Kh., Calculating group explosion parameters with the purpose of increasing the seismic effect, 4:39716
Nechaev, S.V., *See* Burakov, V.S., 4:39975
Nee, J.A., Let's not have another Hells Canyon impasse, 4:38347
Nefedov, A.P., *See* Gaponov, I.M., 4:38964
Nefkens, B.M.K., Differential cross section for proton-proton bremsstrahlung at 1.38 GeV/c, 4:39827
Negri, J.M., Turbocharged engine with vacuum bleed valve, 4:39070
Neidigh, R.V., *See* Murakami, M., 4:39970
Neidlinger, H.H., *See* McCormick, C.L., 4:39235
See Wildman, G.C., 4:39236
Neil, B.C.J., Radioactivity buildup in Pickering nuclear generating station heat transport system, 4:38655
Neilson, G.H., Charge exchange measurements on ISX-A, 4:39979 (ORNL/TM—6823)
See Murakami, M., 4:39970
Nekrasov, S.A., Determining the composition of sand-clay soils from polarization potentials and gamma logging, 4:39515
Nellis, W.J., LLL dynamic high pressure experiments, 4:39981 (UCRL—82272)
See Ross, M., 4:39946
Nelson, D.H., *See* Green, M.I., 4:39458
Nelson, G.C., *See* Holloway, P.H., 4:39776
Nelson, L.S., *See* Buxton, L.D., 4:38823
Nereson, N.G., *See* Begley, R.F., 4:39237
Nesbitt, D.M., *See* Brock, H.W., 4:38863
Neshchimenko, Y.P., *See* Bashkin, A.S., 4:39317
Neuder, S.M., Electromagnetic fields in biological media. I. Dosimetry-a primer on bioelectromagnetics. Final report, 4:39703 (PB—285793)
Neuman, S.P., *See* Narasimhan, T.N., 4:39708
Nevins, J.L., *See* Bucy, J.I., 4:39045
Newell, D.G., *See* Bischoff, W.S., 4:38540, 4:38543
Newell, R.E., A catalog of low-frequency oscillations of the earth's magnetic field as observed at SMS-1 during November 1974—March 1975. Data report, 4:39767 (PB—286773)
Newkirk, H.D., *See* Sartoris, J.J., 4:39632
Newman, E., *See* Moore, J.G., 4:38254
Newman, L., General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL—25114)
Newton, R.G., *See* Lichtenberg, D.B., 4:39959
Neynaber, R.H., Molecular beam studies of low energy reactions. Annual summary report, 4:39788 (AD-A—059845)
Nichols, G.B., Rapping reentrainment in a near full scale pilot electrostatic precipitator. Final report May 1975-April 1978, 4:38603 (PB—284452)
Nicholson, F.D., Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits, 4:38628
Nickell, J.H., Current power plant, 4:38333
Nicklow, R.M., *See* Smith, H.G., 4:39102
Niemann, R.C., *See* Smith, R.P., 4:38958
Nieschmidt, E.B., *See* Dyer, N.C., 4:38633
Niessen, H.F., High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat, 4:39143
Nieto, M.M., Analytic coherent states for generalized potentials, 4:39802 (LA-UR—79-218)
Nikashin, E.S., *See* Nekrasov, S.A., 4:39515
Niles, P., *See* Cooper, P., 4:38424
Niles, P.W.B., Simple direct gain passive house performance prediction model, 4:38454 (CONF-780337—P3, pp 5p, Book 1, Paper 5)
Nilson, R.H., *See* Yoshimura, H.R., 4:39279
Nimmo, R., *See* Kapiloff, L., 4:38178
Nisenoff, M., *See* Edelsack, E.A., 4:39955
Nishi, M., Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL—1521)
Nisley, R.A., *See* Hale, G.M., 4:39883
Nix, J.R., *See* Madland, D.G., 4:39917
Nixon, G.D., *See* Londergan, J.T., 4:39888
Noblett, J.G., Water recycle/reuse alternatives in coal-fired steam-electric power plants. Volume II. Appendixes. Final report June 1975-February 1978, 4:38571 (PB—284676)
Nomura, H., Method and device for monitoring superconducting system, 4:39273
Nomura, K., *See* Kobayashi, K., 4:39083
Noonan, J.R., LEED analysis of the reconstructed Au(110) surface, 4:39104
Northrop, D.A., Enhanced gas recovery program. Third annual report, October 1977—September 1978, 4:38180 (SAND—79-0056)
Nostrand, F.V., *See* Pearlstein, R.M., 4:39243
Nowack, H., Strainrange partitioning applied to Ti—6Al—V, 4:39140
Nunz, G.J., Federal hot dry rock geothermal energy development program: an overview, 4:38547 (LA-UR—79-670)
Nyilas, E., Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB—284092)

O

O'Brien, D.W., Nuclear chemistry counting facilities: requirements definition, 4:39210 (UCID—18151)
O'Brien, K., Mining in canada--a taxing experience, 4:38873
O'Dea, S., *See* Eisenhaure, D., 4:38834
O'Dell, R.D., *See* Dudziak, D.J., 4:38724
O'Hara, J.B., Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7, 4:38051 (FE—1775-18)
Preliminary design services: research and development report No. 114. Final report, 4:38052 (FE—1775-21)
O'Neill, G.K., Satellite solar power station construction in space, 4:38405
Oakes, R.J., *See* Mikaelian, K.O., 4:39844
Oakes, T.W., Brief review of the Resource Conservation and Recovery Act (RCRA) 1976, 4:38875 (CONF-790331—1)
See Eldridge, J.S., 4:38761
Oberle, R.D., *See* Duncan, D.A., 4:38075
Oberman, F.M., *See* Gaponov, I.M., 4:38964
Ochsner, J.C., Source assessment: chemical and fertilizer mineral industry, state-

of-the-art. Final report, October 1976—August 1977, 4:39567 (PB—285662)
Odeh, F., *See* Liniger, W., 4:39956
Odian, A., *See* del Papa, C., 4:39816
Odland, R., Implementation of state solar incentives: state testing and certification, 4:38362 (SERI/TR—51-162)
Ogle, W., *See* Chasman, R.R., 4:39929
Ogorodnikov, A.P., *See* Andreev, A.M., 4:38683
Ohhashi, H., *See* Iimura, H., 4:38735
Ohnishi, A., *See* Saito, N., 4:39085
Ohtou, Y., *See* Iimura, H., 4:38735
Ohtsubo, T., *See* Sugimura, H., 4:38079
Olander, D.R., *See* Dooley, D., 4:39254
See Machiels, A.J., 4:39782
Oldfield, J., *See* Boersma, L., 4:38318
Oldham, R.D., *See* Larsen, R.P., 4:39199, 4:39688
Olien, N.A., *See* Edelsack, E.A., 4:39955
Oliveira, L.F., Abrasion-ablation calculations of large fragment yields from relativistic heavy ion reactions, 4:39935
Olmer, C., *See* Gelbke, C.K., 4:39915
Olsen, B.E., *See* Rakowski, J.E., 4:38799
Olson, O.L., *See* Hard, E.N., 4:38778
Olson, R.E., Review of waste management for a large-scale mixed oxide fuel fabrication facility, 4:38232 (WCAP—9144)
Olszewski, M., Overview of waste heat utilization techniques, 4:39039 (CONF-790443—2)
Ondris, P., *See* Hunt, C.M., 4:39005
Onischak, M., *See* Tran, D.Q., 4:38063
Oppenheimer, J.L., Microcomputer-based multiplexer for performing depth profiling with an Auger electron spectrometer, 4:39774
Oraevskii, A.N., *See* Bashkin, A.S., 4:39304, 4:39305, 4:39317, 4:39318
Orailoglu, A., Multirate ordinary differential equation intergrator, 4:40031 (COO—2383-0056)
Oras, J.J., *See* Sha, W.T., 4:38685
Oren, Y., *See* Gelfand, N., 4:39862
Orr, J., *See* Goodman, A.M., 4:39142
Ortendahl, D., *See* Stetz, A., 4:39847
Orwig, L.E., *See* Dolan, J.F., 4:39742
Orzechowski, T.J., Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
Osada, H., Characteristics of amplified spontaneous emissions in high-gain gas-laser amplifiers, 4:39322
Osher, J.E., Role of space charge in beam transport, 4:39398
Ossakow, S.L., *See* Huba, J.D., 4:39761
Oston, S.G., *See* Byrne, R.J., 4:38267
See Koplick, C.M., 4:38266
Otto, C.H. Jr., *See* Harrar, J.E., 4:38545
Overbey, D.R., *See* Simpkins, J.E., 4:40026
Oversluizen, T., *See* Schuchman, J.C., 4:39330
Owens, M.R., Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12—24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR—3490-1578)
Ozaki, S., MPS configuration and performance characteristics, 4:39433 (BNL—25311)
Ozawa, T., *See* Seikieka, M., 4:38549

P

Paciotti, M., Pion beam development for the LAMPF biomedical project, 4:39453 (LA-UR—79-714)
Pack, J.L., *See* Babcock, R.V., 4:39299
Padova, A., *See* Holtzman, R.B., 4:39600
Paillous, A., Proton and electron irradiation of thermal control coatings and polymeric films. I. Experimental irradiations, 4:39184 (N—78-31252)
Painter, G.S., Theoretical studies of the electronic structure and bonding properties of surfaces, 4:39228 (LBL—8975, pp 58.-59)
Painter, M.J., Design and operation of a dry spent fuel storage installation, 4:38262 (CONF-790602—25)
Pakvasa, S., Some remarks on grand unified models, 4:39835 (UH—511-330-79)
Pallaver, C.B., *See* Mazur, P.O., 4:39274
Palmedo, P.F., Systems framework for energy analysis in developing countries, 4:38860 (BNL—25933)
Palmer, D.W., *See* Draper, B.L., 4:39340
Palmer, R.B., *See* Cnops, A.M., 4:39819
Panabiere, G., *See* Paillous, A., 4:39184
Pangborn, J.B., Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
Panitz, J.K.G., Radio-frequency-sputtered tetragonal barium titanate films on silicon, 4:39180
Pap, G., *See* Ratcliffe, C.T., 4:38607
Papadopoulos, K., *See* Huba, J.D., 4:39766
Pare, V.K., *See* Murakami, M., 4:39970
Parker, E.F., *See* Crabb, D.G., 4:39434
Parker, J.C., Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report, 4:38489 (DOE/NASA/TM—78219)
Development, testing, and certification of Owens—Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM—78223)
Parker, R.K., *See* Granatstein, V.L., 4:39333
See Pasour, J.A., 4:39390
Parks, D.J., Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL—82181)
Parsons, C.L., An evaluation of in situ ozone sensor performance during a cold frontal passage, 4:39532 (N—78-27706)
Parsons, M., *See* Warren, R., 4:40009
Parzen, G., Correction of the closed orbit and vertical dispersion and the tuning and field correction system in ISABELLE, 4:39467 (BNL—25755)
See Claus, J., 4:39471
Pascale, R., *See* Troia, E., 4:38446
Paschos, E.A., *See* Claudson, M., 4:39848
Pashko, S.A., *See* Borodulin, V.I., 4:39316
Paskel, M.T., *See* Webb, W.L., 4:38132
Pasour, J.A., Collective ion acceleration and intense electron beam propagation within an evacuated dielectric guide, 4:39390 (CONF-771035—P2, pp 623-634)
See Granatstein, V.L., 4:39333
Passero, B., Marine-related research at MIT, 1978: including projects on marine-resources, ocean utilization and coastal zone management, 4:39728 (PB—286346)
Patrusheva, V.A., *See* Kozlova, E.F., 4:39720
Patterson, I.G., *See* Middleton, G.J., 4:39034
Paty, M., *See* Read, A.L., 4:39821
Pavlenco, G.F., *See* Hu, M.C., 4:38575
Pawlowski-Konopnicki, B.E., *See* Auer, H.E., 4:39636
Pay, A., *See* van Vliet, J., 4:38675
Pchelkin, V.N., *See* Shinkevich, G.G., 4:38153
Pearce, J.B., *See* Kaiser, M.L., 4:39757
Pearlstein, R.M., Time dependence of triplet—singlet excitation transfer from compact poly rA to bound dye at 77 k, 4:39243
Pearson, J.W., Precision machining vs. optical process, 4:39096 (UCRL—82528)
Pease, R.L., Technology assessment and radiation effects characterization of Integrated Injection Logic. Final report, July—September 1976, 4:39500 (AD-A—058360)
Pease, V.P., *See* McNulty, P.J., 4:39666
Pech, N., *See* Van Zant, G., 4:39640
Peddada, R., *See* Rao, S.T., 4:39558
Peet, N.J., Energy in new housing: economic and technical aspects of alternative sources of supply, 4:38940
Pekrul, P.J., On-line computerized reactor noise, vibration and loose parts monitoring system, 4:38747
Pella, P.A., Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB—285452)
Pellegrini, Free electron laser and its possible developments, 4:39474 (BNL—25857)
Pellegrini, C., *See* Courant, E.D., 4:39470
Pellizzari, E.D., Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB—286483)
Pelte, D., *See* Stokstad, R.G., 4:39911
Pentz, D.L., *See* Byrne, R.J., 4:38267
See Koplick, C.M., 4:38266, 4:38269
Pentz,D.L., *See* Koplick, C.M., 4:38264, 4:38265
Penzien, J., *See* Lee, M.C., 4:38826
Pepe, A., *See* Taylor, W.E., 4:38372, 4:38373
Pereira, C.J., Modeling of the catalytic converter for automotive exhaust gas, 4:39087
Pereira, N.R., Damped double solitons in the nonlinear Schroedinger equation, 4:39998
Perez-Mendez, V., *See* Stetz, A., 4:39847
Perfetti, P., Angle resolved photoemission studies of the GaAs—Ge interface, 4:39954
See Denley, D., 4:39158
Perin, J.M., Multi stage q-switched iodine laser. Master's thesis, 4:39282 (AD-A—057904)
Perkins, J., *See* Katan, T., 4:38848
Perkins, R.A., *See* Koester, J.K., 4:38963
Perl, M.L., *See* Heile, F.B., 4:39846
Perley, P.C., *See* Siems, P.L., 4:38206
Perova, G.K., Spectral method for determining impurities in anthracite and oil coke, 4:38084
Perry, B.I., Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing, 4:39016 (N—78-31043)
Perry, E.R., Heat pump system with improved heat transfer, 4:39002
Perry, J., Improved anodes for liquid hydrocarbon fuel cell. Research and development technical report, 4:38988 (AD-A—058456)
Perry, N.R.F., The energy cost of road and rail transport in Tasmania, 4:39025 (PB—283952)
Pershing, D., *See* Pasour, J.A., 4:39390

Peruso, C.J., Life test results for an ensemble of CO^2 lasers, 4:39290 (N—78-27404)
Peters, G.J., An investigation of the far ultraviolet spectra of the pole-on Be stare mu Cen and upsilon Cyg. Final technical report, 4:39735 (N—78-31018)
Peters, W.A., *See* Bush, T.W., 4:38080
Petersen, H., *See* Bauer, R.S., 4:39189
Petersen, J.V., Theoretical modelling of charge transfer lasers, 4:39321
Peterson, H.A., Superconductive energy storage for power systems, 4:38831
Peterson, R.J., *See* DiGiacomo, N.J., 4:39907
See Dytman, S.A., 4:39896
Peterson, S.W., *See* Liu, M.B., 4:39099
Peterson, W.K., Preliminary report. R/V Thomas G. Thompson cruise TT-122, 4:39611 (DOE/EV—75027-58)
Petreta, S., *See* Read, A.L., 4:39821
Petrov, N.K., *See* Kozlov, Y.I., 4:39315
Petrov, V.A., *See* Demidov, B.A., 4:39395
Pettigrew, M.J., Vibration of heat exchange components in liquid and two-phase cross-flow, 4:38731 (AECL—6184)
Petty, S., *See* Cole, J., 4:38975
Pfaffenberger, W., Possibilities and limits of energy conservation in the Federal Republic, 4:38898
Pfafflin, G.E., Tube turbines, 4:38337
Pfister, P.J., Lindeberg residence: a DOE funded hybrid solar house, 4:38438 (CONF-780337—P2, pp 6p, Book 2, Paper 8)
Report of the solar passive subcommittee for the Minnesota Energy Agency: review and update, 4:38363 (CONF-780337—P1, pp 4p, Book 1, Paper 5)
Phani, M.K., Monte Carlo study of an ordering alloy on an fcc lattice, 4:39949
Philippot, J.Cl., *See* Bovard, P., 4:39495
Phillips, J.R., *See* Hsue, S.T., 4:38239
Phillips, P.H., *See* Harris, G.S., 4:38913
Phillips, R.L., Origin of gross structure in $^{12}C + {}^{12}C$ and $^{16}O + {}^{16}O$ inelastic scattering, 4:39886
Phillips, T.D., Nuclear incident monitor, 4:39492 (DP—1501)
Phinney, H., *See* Boersma, L., 4:38318
Pianetta, P., *See* Lindau, I., 4:39953
Pickett, W.E., Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
See Ho, K.M., 4:39157
Picraux, S.T., Application of ion channeling to radiation damage studies, 4:39168 (SAND—79-0497C)
See Wampler, W.R., 4:40006
Piercey, R.B., *See* Maguire, C.F., 4:39902
Pietrik, I., *See* Moravek, J., 4:38737
Pigford, T.H., Comprehensive standards: the power generation case, 4:38599 (PB—286024)
Pilling, R.G., Energy conservation in the New Zealand meat export industry, 4:39038
Pinkernell, H., Transmission and distribution of information in power plants, 4:38753 (AED-Conf—78-155-033)
Pinkhasik, M.S., *See* Pishchikov, S.I., 4:38954
Pishchikov, S.I., Studies at the U-25 MHD pilot plant, 1977—1978, 4:38954 (CONF-781009—, pp 117-128)
See Sheindlin, A.E., 4:38945
Piskarskas, A., *See* Birmontas, A., 4:39307
Pivovarov, B.L., *See* Kalinin, A.V., 4:39715
Pizzo, V.J., A three-dimensional model of corotating streams in the solar wind. 1: theoretical foundations, 4:39744 (N—78-28031)
Place, W., Solar resource: motion and amplitude, 4:38356 (CONF-780337—P2, pp 4p, Book 1, Paper 2)
See Holtz, M.J., 4:38471
Planquart, J., *See* Hebel, W., 4:38782
Platts, J., Electrical load management: the British experience. Part II, 4:38937
Plondke, N.J., *See* Holtzman, R.B., 4:39680
See Rundo, J., 4:39579
Plum, R.L., *See* Guiffre, M.S., 4:38268
Pochan, M.J., Computer-aided analysis of coal gasification pilot plant data bases, 4:38060 (FE—2496-26)
Poggio, E.C., Vacuum-polarization-corrected long-distance static quark-antiquark potential, 4:39874
Pohl, J., *See* Haggard, K., 4:38427
Pohlman, S.L., *See* Smyrl, W.H., 4:39183
Pole, C.D., *See* Booth, W.G., 4:38122
Poli, D.L., Security seal handbook, 4:38294 (SAND—78-0400)
Policastro, A.J., Evaluation of integral and phenomenological models for heated surface plumes with field data, 4:39625
Numerical modeling of surface thermal plumes, 4:39626
Polk, I., *See* Buchanan, V., 4:39472
Pollack, A.M., Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB—285646)
Polozova, I.E., *See* Mamontov, A.M., 4:39164
Polyakov, V.I., *See* Gryazev, V.M., 4:38682
Polyanichev, A.N., Absorption of laser radiation by a dense expanding plasma, 4:39986
Pondrom, L., *See* Fung, S., 4:39455
Pope, R.B., *See* Yoshimura, H.R., 4:39279
Popeko, A.G., *See* Flerov, G.N., 4:39919
Portch, R., Water quality/biological surveillance program for CDIF support , 4:38951 (FE—2524-8, pp 155-161)
Porterfield, J., *See* Hunt, C.M., 4:39005
Postlethwaite, A.W., *See* White, L.R., 4:38959
Pott, G, Qualification of HTGR fuel by rig development and irradiation testing at BR2 Mol, 4:38640 (INIS-mf—4426, pp IV.1-16)
Potter, J.M., Experimental and calculated rf properties of the disk-and-washer structure, 4:39449 (LA-UR—79-685)
Radio frequency quadrupole accelerating structure research at Los Alamos, 4:39401 (LA-UR—79-695)
See Frank, J.S., 4:39832
Potter, R.C., *See* Love, C.C., 4:38639
Poullot, B., Device for controlling the composition of the exhaust gases from a heat engine, 4:39080
Pouska, G.A., *See* Link, J.M., 4:38186
Powell, D.J., *See* Cotter, J.E., 4:38199
Powell, G.H., *See* Lee, M.C., 4:38826
Powell, H.T., Sulfur $^1S_0$-$^1D_2$ laser by OCS photodissociation, 4:39295
Powell, J.L., Department of Energy fossil energy equipment development programs, 4:38048 (CONF-790405—14)
Powell, J.R., Fusion reactors for synthetic fuels, 4:38301 (BNL—25634)
See Botts, T.E., 4:38601
See Steinberg, M., 4:38225
See Tsang, J.S.K., 4:40005
See Yu, W.S., 4:39438
Pownell, J.E., *See* Hymowitz, E.W., 4:38474
Pozinsky, G., *See* Hunter, E.E., 4:39899
Prasad, M., *See* Shankar, R., 4:39812
Pravdo, S.H., Discovery of iron line emission in the Hercules X-1 low-state spectrum with HEAO-1, 4:39740 (N—78-31038)
See Mushotzky, R.F., 4:39741
Preedom, B.M., *See* Dam, S.H., 4:39903
Prentice, J.D., *See* Caldwell, D.O., 4:39817
Prerau, D., *See* Bland, R., 4:38172
Prescott, C.Y., Parity non-conservation in inelastic electron scattering, 4:39870
Parity violation in inelastic scattering of polarized electrons, 4:39815 (SLAC-PUB—2218)
Price, V., *See* Jones, P.L., 4:38207
Prien, C.H., *See* Cotter, J.E., 4:38199
Prince, E.T., Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
Probert, P.B., *See* Dicks, J.B., 4:38950
Prodell, A.G., *See* Allinger, J., 4:39436
Prokop, A.S., *See* Bitiurin, V.A., 4:38955
Proksch, E., Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE—2875)
Pronko, P.P., *See* Appleton, B.R., 4:39196
Prosnitz, D., *See* Powell, H.T., 4:39295
Provo, J.L., Effects of vacuum processing erbium dideuteride/ditritide films deposited on chromium underlays on copper substrates, 4:39172
Prowler, D., *See* Duncan, I.P., 4:38460
Prowse, D.R., Safety analysis of the proposed Canadian geologic nuclear waste repository, 4:38280
Pruess, K., Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies, 4:38512 (LBL—8802)
See Charlton, L.A., 4:39937
Pshezhetskii, S.Y., *See* Bashkin, A.S., 4:39318
See Kolchin, Y.A., 4:39314
See Kozlov, Y.I., 4:39315
Pundyk, J.M., *See* Rozenman, T., 4:38576
Purohit, G.P., *See* Leising, C.J., 4:39053
Puronen, E., *See* Littman, F.E., 4:39585
Pusch, W.H., *See* Joseph, C., 4:38144

Q

Quigg, C., Lecture I. Introduction to charm, 4:39854 (FERMILAB-CONF—78/37-THY, pp 1-28)
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF—78/37-THY, pp 29-60)
Lecture III. Production of charm, 4:39833 (FERMILAB-CONF—78/37-THY, pp 61-80)
Lecture IV. Experimental status of charm, 4:39860 (FERMILAB-CONF—78/37-THY, pp 80-104)
Lecture V. The new new particles, 4:39830 (FERMILAB-CONF—78/37-THY, pp 105-128)
Lectures on charmed particles, 4:39853 (FERMILAB-CONF—78/37-THY)
Multilepton final states and the weak interactions of the fifth quark, 4:39850
Quigley, M.S., Physical modeling of joule heated ceramic glass melters for high level waste immobilization, 4:38256 (PNL—2809)
Quigley, R.W., Third overlay, 4:38425 (CONF-780337—P1, pp 7p, Book 3, Paper 1)
Quintenz, J.P., *See* Johnson, D.J., 4:39780
Quirk, T.W., *See* Kirk, T.B.W., 4:39825

R

Raaen, V.F., *See* Collins, C.J., 4:38071
Rabinowitz, M., *See* Perry, E.R., 4:39002
Radmer, R.J., *See* Kok, B., 4:39555
Radziemski, L.J., *See* Begley, R.F., 4:39237
Ragheb, M.M.H., Nuclear performance of molten salt fusion—fission symbiotic systems for catalyzed DD and DT reactors, 4:40010 (ORNL/TM—6560)
Rahman, A., Science, technology, and development in a new social order, 4:38872
See Chen, S., 4:39961
Raible, B., *See* Dio, W.H., 4:38629
Raithby, G.D., *See* Hollands, K.G.T., 4:38495
Raja, R., *See* Kirk, T.B.W., 4:39825
Rajala, R.E., *See* Carpenter, R.L., 4:39599
Raka, E., *See* Weng, W.T., 4:39469
Rakhimkulov, I.F., *See* Gabdrakhmanov, A.G., 4:38156
Rakowski, J.E., One-fifth scale full-array test report. Final report, 4:38799 (GA-A—14546)
Ramaty, R., *See* Crannell, C.J., 4:39751
Ramayya, A.V., *See* Maguire, C.F., 4:39902
Ramer, J.L., Solar pulser for laser pumping, 4:39303
Ramponi, A.J., Application of x-ray emission spectra to the identification of particulate sulfur compounds in ambient air, 4:39544 (LBL—7284)
Ramspott, L.D., Waste-isolation projects, FY 1978, 4:38275 (UCRL—50050-78)
Randall, C.C., *See* Bastin, J.J., 4:38229
Randic, M., Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
Ranken, W.A., *See* Keddy, E.S., 4:39258
Rao, S.T., Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975—March 1977, 4:39558 (PB—284866)
Rapp, C.F., Glasses suitable for laser application, 4:39300
Rasmussen, J.O., *See* Oliveira, L.F., 4:39935
Ratcliff, K.F., *See* Kung, C.L., 4:39936
Ratcliffe, C.T., Process for removing sulfur dioxide from waste gases, 4:38607
Ratner, L.G., *See* Crabb, D.G., 4:39434
Ratto, J.J., *See* Skowronski, R.P., 4:38076
Ratzel, A.C., Heat loss reduction techniques for annular solar receiver designs, 4:38499 (SAND—78-1769)
See Harrison, T.D., 4:38498
Ravishankara, A.R., *See* Tully, F.P., 4:39538
Ray, W. Jr., *See* Holland, R.E., 4:39894
Rayford, W.E., *See* Wing, R.E., 4:39351
Raymond, J.P., *See* Pease, R.L., 4:39500
Raymond, P., Application of the FLIRA code to fit ERSEC experiments, 4:38792 (CEA-CONF—3999)
Razdobarin, G.T., *See* Burakov, V.S., 4:39975
Razga, J., *See* Horyna, J., 4:38769
Raznitsin, V.V., *See* Gaziyants, A.P., 4:38173
Rea, S.N., Continuous Czochralski process development. LSSA large area silicon sheet task. Annual report, October 1977—September 1978, 4:38375 (DOE/JPL/954887—4)
Read, A.L., Search for short-lived particles in high-energy neutrino interactions identified using a hybrid emulsion—spark-chamber arrangement, 4:39821
Read, M.E., *See* Adler, R., 4:39382
Reams, P.W., Marketing low-head hydroelectric power, 4:38346
Rebka, G.A. Jr., Pion-nucleon interaction and mesonic atoms. Progress report, 1 February 1978—31 January 1979, 4:39829 (COO—2197-63)
Red'kin, V.B., *See* Bystry, A.I., 4:38979
Reddy, B.S., Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR—3490-1574)
See Sakore, T.D., 4:39244
Reddy, V.N., *See* Kinsey, V.E., 4:39668
Redwine, R.P., *See* Frank, J.S., 4:39832
Reed, G.T., Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB—286229)
Reed, J.W., Wind power climatology of the United States: supplement, 4:38562 (SAND—78-1620)
Reed, R.P., Techniques and problems relating to in situ measurment of stress waves in rubblization experiments, 4:38189 (SAND—78-2268C)
Rehmann, K.V., *See* Ley, W., 4:38389
Reiber, M., Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 5. Conveyor belts. Final report, 4:38114 (DOE/TIC—10053(Vol.5))
Reich, M., *See* Agrawal, A.K., 4:38812
Reichard, T., *See* Waksman, D., 4:38494
Reichle, D.E., *See* Auerbach, S.I., 4:39581
Reid, R.E., Catalytic hydrogenation process, 4:39246
Reigel, F.O., *See* Kuzmenko, P., 4:38980
Reinhardt, C.M., Flexible connectors, 4:38184 (CONF-7611113—, pp 12p, Paper 1)
Reinhardt, K.H., Gases and corrosion products in the primary circuit of the NS 'Otto Hahn', 4:38786 (GKSS—77/E/35)
See Smith, I.J., 4:38787
Reis, A.H. Jr., *See* Liu, M.B., 4:39099
Reisfeld, M.J., *See* Begley, R.F., 4:39237
Reiss, Y., Criticality calculations with various weighted difference equations, 4:38721 (INIS-mf—4052, pp 235-240)
Reiswig, R.D., *See* Agnew, L., 4:39450
Rej, A., *See* Brzozka, E., 4:38096
Rekov, A.I., *See* Telegin, G.P., 4:38967
Renier, J.P., *See* Burns, T.J., 4:39460
Renn, O., Nuclear energy from the point of view of the population. Analysis of attitudes and motives, 4:38810 (KFA-AKI-IB—1/77)
Renner, T.R., Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca, 4:39905
Renton, J.J., Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR—79/5)
Repeta, L., *See* Yamin, P., 4:39435
Reshetov, V.I., *See* Kozlovskii, V.I., 4:39308
Retallick, F.D., Open cycle coal fired MHD plants as part of the electric utility system, 4:38946 (CONF-781009—, pp 105-116)
Retels, J., *See* Delbrassine, A., 4:38674
Reucroft, P.J., Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL—8975, pp 22.)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1—July 31, 1978, 4:38056 (FE—2229-10)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, August 1, 1978—October 31, 1978, 4:38057 (FE—2229-11)
Reznek, B., An annotated compilation of the sources of information related to the usage of electricity in non-industrial applications. Final report, 4:38931 (PB—285260)
Rhee, M.J., *See* Meger, R.A., 4:39389
Rhee, S.S., *See* Jones, G.T., 4:38374
Rice, C.K., *See* Ellison, R.D., 4:38992
Rice, M., *See* Stoering, J.P., 4:39960
Richardson, W.B., *See* Graf, G.L., 4:38194
Richter, R.M., *See* Barale, J.J., 4:39457
Ricker, C.W., *See* Kryter, R.C., 4:38730
Ricks, N.R., *See* Start, G.E., 4:38763
Riddle, A.C., *See* Kaiser, M.L., 4:39757
Rieber, M., Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 1. Summary and conclusions. Final report, 4:38110 (DOE/TIC—10053(Vol.1))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 2. Unit trains. Final report, 4:38111 (DOE/TIC—10053(Vol.2))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 3. Coal slurry pipelines. Final report, 4:38112 (DOE/TIC—10053(Vol.3))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 4. Barge transport. Final report, 4:38113 (DOE/TIC—10053(Vol.4))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 6. Truck haulage. Final report, 4:38115 (DOE/TIC—10053(Vol.6))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 7. Pneumatic transport. Final report, 4:38116 (DOE/TIC—10053(Vol.7))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 8. Yellow ball rail. Final report, 4:38117 (DOE/TIC—10053(Vol.8))
Riggsbee, W.H., Hydro choice: high, low, or no, 4:38327
Riley, J.A., Some aspects of water chemistry in the CSGHWR, 4:38656
Ring, P.J., *See* Spalaris, C.N., 4:38667
Ripin, B.H., *See* Armstrong, C.M., 4:39985
Ristinen, R.A., *See* DiGiacomo, N.J., 4:39907
Ritchie, R.H., *See* Ashley, J.C., 4:39939
Rivera, O., *See* Paciotti, M., 4:39453
Roark, W.H., *See* Collins, C.J., 4:38071
Robinette, M.J., *See* Lomax, C.C., 4:38331
Robinson, B., *See* Dris, M., 4:39826
Robinson, J.N., Measurement error in pressure-decay leak testing, 4:39259 (ORNL/TM—6855)
Robinson, M.T., *See* Hoffman, T.J., 4:39781
Robinson, R.L., *See* Ball, J.B., 4:39441
Rochester, L.S., *See* Prescott, C.Y., 4:39870
Rodenz, G.W., *See* Potter, J.M., 4:39401

Rogers, C.L., *See* Beazley, R., 4:38093
Rogers, G.C., *See* Moore, J.G., 4:38254
Rogers, J.W., Coupled Fast Reactivity Measurements Facility (CFRMF), 4:38779 (IAEA—208(Vol.2), pp 117-176)
Rogers, J.W. Jr., *See* Taylor, T.N., 4:39154
Rogers, L.E., *See* Klepper, E.L., 4:38271
Rogozen, M.B., *See* Anderson, O.L., 4:38121
Rohlich, G.A., *See* Thompson, W.T., 4:38261
Rohwedder, D., Energy policy prospects as viewed by the Federal Government, 4:38924
Romano, G., *See* Read, A.L., 4:39821
Romanov, A.I., *See* Gokhstein, Ya.P., 4:38978
See Schneider, S.J., 4:39165
See Telegin, G.P., 4:38967
Romero, L.S., *See* Larson, D.E., 4:38255
Roney, W., *See* Bitter, M., 4:39973
Rosenblatt, M., *See* Helland, K.N., 4:39983
Rosenblum, L., Cost of photovoltaic energy systems as determined by balance-of-system costs, 4:38380 (N—78-27539)
Rosengaus, E., *See* Nishi, M., 4:40020
Rosner, J.L., *See* Quigg, C., 4:39850
Ross, D.W., *See* Strauss, H.R., 4:39991
Ross, M., High temperature science: future needs and anticipated development in high-density shock-wave research, 4:39946 (UCID—18072)
Rossbander, W.R., General principles of organization and design of monitoring programmes, 4:38774
Rossi, G., *See* Cavaleri, L., 4:38561
Rossidivito, E.L., *See* Earley, R.F., 4:38360
Rossnagel, S.M., AES study of the adsorption of O_2, CO, CO_2, and H_2O on indium, 4:39152
See Dylla, H.F., 4:40024
See Wampler, W.R., 4:40006
Rost, E.S., *See* DiGiacomo, N.J., 4:39907
Rostoker, N., Toroidal collective accelerator for heavy ions, 4:39391 (CONF-771035—P2, pp 635-645)
Rosynek, M.P., Influence of f-electron configuration on catalytic properties of lanthanide oxides, 4:39242 (LBL—8975, pp 75.-76.)
Rosynsky, V., Catalytic apparatus, 4:39081
Roth, J.R., *See* Singh, C.M., 4:39997
Rothmuller, I.J., *See* Argo, P.E., 4:39765
Rothschild, R.E., *See* Pravdo, S.H., 4:39740
Rotinov, A.G., *See* Maslennikov, V.M., 4:38960
Row, D.G., *See* Lee, M.C., 4:38826
Rowe, A.P., *See* Zellars, G.R., 4:38126
Rowland, R.E., Dose-response relationships for female radium dial workers, 4:39673 (ANL—78-65(Pt.2), pp 7)
Plutonium injection cases: an update to 1977, 4:39682 (ANL—78-65(Pt.2), pp 138-141)
See Stehney, A.F., 4:39674
Rozenblyum, N.D., *See* Mitel'man, M.G., 4:39491
Rozenman, T., Optimization of design specifications for large dry cooling systems. Final report, June 1975—June 1978, 4:38576 (PB—285924)
Rubbia, C., Relativistic electron cooling for high luminosity proton-anti proton colliding beams at very high energies, 4:39413 (LBL—7574, pp 98-101)
See Cline, D., 4:39422
Rubow, K., *See* Marple, V.A., 4:38102
Ruby, J.D., *See* McCone, A.I., 4:38566
Ruefli, T., Horizontal divestiture of energy companies, 4:38925
Ruff, R.E., Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB—284400)
Ruge, J.L., *See* Schimmoeller, H.A., 4:39132
Ruggera, P.S., Measurements of electromagnetic fields in the close proximity of CB antennas, 4:39701 (FDA—79-8080)
Ruggiero, A., *See* McIntyre, P., 4:39416
Ruggiero, A.G., Are we beating Liouville's theorem, 4:39415 (LBL—7574, pp 123-128)
Beam stability considerations during electron cooling, 4:39419 (LBL—7574, pp 161-164)
High-energy electron cooling, 4:39421 (LBL—7574, pp 166-170)
Stochastic cooling with noise and good mixing, 4:39417 (LBL—7574, pp 150-154)
Ruiz, H.V., Excitation function for ^{15}O production via the ^{14}N (d,n)^{15}O reaction, 4:39898
Rumble, R.P., LLL field test systems division support to the U.S. Nuclear Regulatory Commission. FY 1978 progress report, 4:38827 (UCRL—52708)
Rummery, T.E., Formation, composition and structure of corrosion products in CANDU nuclear power reactors, 4:38657
Rumpf, J., *See* Albrecht, L., 4:38828
Rundo, J., Blood content and excretory plasma clearance of plutonium 10^4 days after injection, 4:39687 (ANL—78-65(Pt.2), pp 142-144)
Ingestion of ^{241}Am sources intended for domestic smoke detectors: report of a case, 4:39683 (ANL—78-65(Pt.2), pp 154)
Postprandial changes in the exhalation rate of radon produced in vivo, 4:39578 (ANL—78-65(Pt.2), pp 118)
Postprandial changes in the exhalation of radon from the environment, 4:39579 (ANL—78-65(Pt.2), pp 119-126)
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL—78-65(Pt.2), pp 95-108)
Rupp, W., *See* Fischer, W., 4:38851
Rusche, R., *See* Klainer, S.M., 4:39281
Rushford, M.C., *See* Hackel, L.A., 4:39787
Russell, P.B., *See* Ruff, R.E., 4:39554
Ruth, R.D., *See* Crabb, D.G., 4:39434
Ryan, B.Y. Jr, *See* Hampton, N.F., 4:38879
Ryan, J.W., *See* Ruff, R.E., 4:39554
Ryan, P.M., *See* Stirling, W.L., 4:40011
Rye, R.R., Chemical information in Auger spectroscopy, 4:39241 (LBL—8975, pp 40.-41.)
Ryon, R.W., *See* Harrar, J.E., 4:38545
Ryzhik, V.M., *See* Kisilenko, B.E., 4:38196

S

Saad, S., *See* Witherow, J.L., 4:39044
Sacherer, F.J., Stochastic cooling theory, 4:39412 (LBL—7574, pp 93-97)
Sacton, J., *See* Read, A.L., 4:39821
Sadowski, E.P., Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1—May 31, 1978, 4:38061 (FE—2621-3)
Saito, H., *See* Araki, T., 4:39353
Saito, N., Exhaust gas recirculation system, 4:39085
Saito, R., *See* Araki, T., 4:39353
Sakore, T.D., Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3'-5')guanosine, 4:39244 (UR—3490-1573)
See Reddy, B.S., 4:39245
Salamon, M.H., *See* Ahlen, S.P., 4:39504
Salmon, R., *See* Edwards, M.S., 4:38047
Saltmarsh, M.J., *See* Murakami, M., 4:39970
See Ragheb, M.M.H., 4:40010
Salvesen, K.G., Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report, 4:39565 (PB—285429)
Salvini, G., *See* Fung, S., 4:39455
Salyer, I.O., *See* Whitaker, R.B., 4:38506
Samios, N.P., *See* Cnops, A.M., 4:39819
Samson, A.M., Features of high-frequency pulsation generation in a ring laser with detuning, 4:39319
Samuel, M.A., *See* Laursen, M., 4:39845
Sandel, F.L., *See* Marshall, T.C., 4:39335
Sander, O.R., *See* Nefkens, B.M.K., 4:39827
Sanders, J.W., Rocky Flats experience with SDM/70, 4:40041 (RFP—2902)
Sandford, S., *See* Paciotti, M., 4:39453
SanFilippo, G.P., *See* Guckert, L.G., 4:38142
Sanghi, A.K., The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB—286002)
Sani, E., Kriging method versus classical statistics in estimating mineral reserves, 4:38889
Sano, S., *See* Baba, K., 4:38536
Santonico, R., *See* Read, A.L., 4:39821
Santoro, R.T., *See* Ragheb, M.M.H., 4:40010
Santurian, G.R., *See* Kazanovich, B.B., 4:38577
Sanyal, S.K., Geothermal well log interpretation midterm report, 4:38524 (LA—7693-MS)
Sard, R.D., *See* Kirk, T.B.W., 4:39825
Sargent, G.A., *See* Reucroft, P.J., 4:38056, 4:38057
Sarle, C.R., Turbocharger lubrication and exhaust system, 4:39059
Sarracino, J.S., *See* Bowman, J.D., 4:39818
Sartoris, J.J., Historical, physical, and chemical limnology of Twin Lakes, Colorado, 4:39632 (PB—283848)
Sastre, C., *See* Agrawal, A.K., 4:38812
Sato, K., How to develop geothermal energy in Japan, 4:38537
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA—7445-C, pp 139-173)
See Baba, K., 4:38536
See Seikieka, M., 4:38549
Sato, M., Recent developments in geothermal multipurpose utiliztaion in Jozankei Hot Springs in Sapporo City, 4:38552
Sato, T., *See* Prescott, C.Y., 4:39870
Satre, W.J., Role of a private utility in production of energy, 4:38934
Sauerlender, O.H., *See* Gamble, H.B., 4:38759
Sauthoff, N.R., *See* Bitter, M., 4:39973
Savit, R., *See* Einhorn, M.B., 4:39840
Savory, J.R., *See* Katan, T., 4:38848
Sax, R.L., *See* Dietz, D.L., 4:39525
Sayer, R.O., *See* Ball, J.B., 4:39441
See Knudsen, H., 4:39940
Scanu, A.M., *See* Barbeau, D.L., 4:39643
Scarlett, W.R., The charge and energy spectra of heavy cosmic ray nuclei, 4:39729 (N—78-29031)
Schade, A.R., FSAR Amendment 34: environmental technical specifications for the Fast Flux Test Facility

(Chapter 18), 4:38701 (HEDL-TI—75002-34)
Schaefer, A.O., Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, April 1, 1978—June 30, 1978, 4:38053 (FE—1784-42)
Schaefer, D.W., Static correlations in semidilute polymer solutions, 4:39181 (CONF-790415—24)
Schaefer, L., *See* Karsten, G., 4:38676
Schalk, T., *See* del Papa, C., 4:39816
Schardt, A.W., Discrepancy in proton flux extrapolation along field lines in the middle Jovian magnetosphere, 4:39759 (N—78-31028)
Scharer, J.E., Fast magnetosonic wave heating of the NUWMAK tokamak reactor, 4:39966 (UWFDM—227)
Scharner, P., *See* Baresel, D., 4:39086
Schatten, K.H., A physical mechanism for the prediction of the sunspot number during solar cycle 21, 4:39746 (N—78-29028)
Schechter, D.E., *See* Stirling, W.L., 4:40011
Schechter, R.S., Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977—September 1978, 4:38138 (BETC—0001-1)
Scheithauer, R., *See* Giese, R., 4:38897
Schelske, C.L., Nutrient enrichment and eutrophication of Lake Michigan. Progress report, November 1, 1975—September 30, 1978, 4:39608 (COO—2003-T1)
Schenk, W., Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures, 4:38809 (Juel—1490)
Schenter, R., *See* Mann, F., 4:39921
Scherrer, P.H., *See* Schatten, K.H., 4:39746
See Svalgaard, L., 4:39747
Schiff, M., House at Crooked Creek. Direct gain passive solar design in an extreme climate, 4:38444 (CONF-780337—P2, pp 5p, Book 2, Paper 14)
Solar heated greenhouse, 4:38448 (CONF-780337—P2, pp 2p, Book 3, Paper 4)
Schiffmacher, S.A., *See* Edelsack, E.A., 4:39955
Schimmoeller, H.A., Estimation of residual stresses in reactor pressure vessel steel specimens clad by stainless steel strip electrodes, 4:39132
Schleicher, B.R., *See* Powell, H.T., 4:39295
Schlenker, R.A., *See* Evans, R.D., 4:39661
See Harris, M.J., 4:39677
See Mausner, L.F., 4:39678
Schlesinger, S.P., Zero frequency pumped stimulated Raman scattering by an intense relativistic electron beam, 4:39334 (CONF-771035—P2, pp 691-696)
Schlessinger, L., Inverse bremsstrahlung absorption rate in an intense laser field, 4:39796 (UCRL—13965)
Schmidt, J., Mining and mineral fuel development in the Montana statewide 208 study area: implications to water quality. Final report, 4:39619 (PB—286217)
Schmidt, P.P., The evaluation of matrix elements with generalized spherical Gaussian wavefunctions Part I. Single-particle, one- and two-centre forms. Technical report no. 1, 1 May 77—31 Apr 78, 4:39800 (AD-A—059533)
Schmidt-Collerus, J.J., *See* Cotter, J.E., 4:38199
Schmisseur, W.E., *See* King, L.D., 4:39657
Schmitt, F.M., *See* Read, A.L., 4:39821
Schmitt, R.C., *See* Sha, W.T., 4:38685
Schmitz, G., Control of airborne radioactive releases from nuclear power plants in the Federal Republic of Germany, 4:38775
Schneegans, M., *See* Read, A.L., 4:39821
Schneider, H., *See* Dowdy, M., 4:39054, 4:39063
Schneider, J.R., *See* Larsen, R.P., 4:39688
Schneider, M., Design concepts for solar heating in a Mediterranean climate, 4:38461 (CONF-7709179—1)
Schneider, R.T., Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission), 4:38788
Schneider, S.J., Materials, 4:39165
Schnepf, R., Iodine filter testing, 4:38744
Schnetzer, S., *See* Lemaire, M.C., 4:39887
Schnitzer, H.J., Quantum chromodynamics and the spin-dependent quark-antiquark forces, 4:39838
See Poggio, E.C., 4:39874
Schoen, A.A., Effluent monitoring: Its purpose and value, 4:38776
See Elle, D.R., 4:39583
Schrack, R.A., *See* Lamaze, G.P., 4:39897
See Wasson, O.A., 4:39943
Schreckhise, R.G., *See* Klepper, E.L., 4:38271
Schreier, J.S., Fuel-oil mixing apparatus for internal-combustion engines, 4:39069
Schriber, S.O., Room-temperature cavities for high-beta accelerating structures, 4:39446 (LA-UR—79-463)
See Potter, J.M., 4:39449
Schroeder, L., Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134
Schroeder, R., *See* Goranson, C., 4:38526
Schroeder, R.C., *See* Narasimhan, T.N., 4:38546
See Pruess, K., 4:38512
Schuchman, J.C., Vacuum system for National Synchrotron Light Source, 4:39330
See Krinsky, S., 4:39468
Schueckler, M., *See* Bayer, A., 4:38824
Schuldt, R.L., *See* Manchester, D.F., 4:38991
Schuller, C.R., *See* Lippek, H.E., 4:38246
Schultheis, H., Energy dissipation in ^{235}U(n/sub th/,f), 4:39918 (ORO—5126-62)
Schultheis, R., *See* Schultheis, H., 4:39918
Schultz, E., Stony Brook booster project update, 4:39372 (LA—7445-C, pp 235-236)
Schultze, H., *See* Wolf, D., 4:39061
Schumacher, R., New and already approved - the power plant control system PROCONTROL K by Brown-Boveri, 4:38752 (AED-Conf—78-155-027)
Schumann, P., *See* Grabner, A., 4:38637
Schumann, S., *See* Elston, S.B., 4:39798
Schuster, C.L., *See* Northrop, D.A., 4:38180
Schwarz, C.E., *See* Greene, G.A., 4:38791
Schweitzer, D.G., *See* Agrawal, A.K., 4:38812
Schwitters, R.F., Experimental review of beam polarization in high energy e^+e^- storage rings, 4:39481 (SLAC-PUB—2258)
Scott, D.K., *See* Gelbke, C.K., 4:39915
Scott, D.R., Solar tracking control system Sun Chaser, 4:38491 (DOE/NASA/TM—78225)
Scott, G.C., *See* Harris, G.S., 4:38913
Scott, M.H., Plasma luminosity fluctuations as a diagnostic tool, 4:38984
See Wu, Y.C.L., 4:38956
Scott, M.I., *See* Pangborn, J.B., 4:38175
Scudder, J.D., A theory of local and global processes which affect solar wind electrons. 1: The origin of typical 1 AU velocity distribution functions: steady-state theory, 4:39750 (N—78-31033)
Scully, D., Knowing and loving, and never knowing: two houses, 4:38442 (CONF-780337—P2, pp 5p, Book 2, Paper 12)
Seale, S.K., *See* Crowe, J.L., 4:39352
Seguchi, K., *See* Araki, T., 4:39353
Seibert, M., *See* Weaver, P., 4:38309
Seiden, A., *See* del Papa, C., 4:39816
Seidle, N., Mine machinery trainer, development and fabrication, 4:38100 (PB—284196)
Seikieka, M., Report of the Geothermal Utilization Committee, 4:38549
Seila, A.F., An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974—30 June 1977, 4:38938 (PB—284018)
Seixas de Oliveira, L.F., Large fragment production calculations in relativistic heavy-ion reactions, 4:39865 (LBL—8561)
Sekioka, M., *See* Sato, M., 4:38552
Self, S.A., *See* Ariessohn, P., 4:38966
See Kuzmenko, P., 4:38980
Selove, W., *See* Dris, M., 4:39826
Semenov, V.V., *See* Burakov, V.S., 4:39975
Semikov, G.T., *See* Andreev, A.M., 4:38683
Sen, A., *See* Karney, C.F.F., 4:39999
Sengupta, S., *See* Lee, S.S., 4:39627
Seraphin, B.O., Chemical vapor deposition of spectrally selective surfaces for high-temperature photothermal conversion, 4:38393
Serdula, K.J., *See* Bazerghi, H., 4:38741
Serio, C.S., Lymphoblastogenesis in response to phytohemagglutinin in radium patients: quantitative aspects and reproducibility, 4:39676 (ANL—78-65(Pt.2), pp 43-54)
Serlemitsos, P.J., *See* Mushotzky, R.F., 4:39739, 4:39741
See Pravdo, S.H., 4:39740
Serne, J.C., The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976—April 1978, 4:39561 (PB—284973)
Serot, D.E., *See* Earley, R.F., 4:38360
Servranckx, R.V., Chromatic corrections for large storage rings, 4:39485 (SLAC-PUB—2270)
Seshadri, T.P., *See* Reddy, B.S., 4:39245
Sessler, A.M., Overview of beam cooling, 4:39409 (LBL—7574, pp 53-55)
Sessler, G.L., *See* Pigford, T.H., 4:38599
Sessoms, A.L., *See* Kirk, T.B.W., 4:39825
Severyn, J., *See* Campbell, D., 4:40014
Sha, J.Y., *See* Holtzman, R.B., 4:39680
See Rundo, J., 4:39578, 4:39679
Sha, W.T., COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis, 4:38685 (NUREG/CR—0785)
Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system, 4:38684 (NUREG/CR—0001)
Shaffer, R.J., *See* Hanson, M.E., 4:38181, 4:38182
Shampine, L.F., Lipschitz constants and robust ODE codes, 4:40042 (SAND—79-0458C)
Shanahan, W.R., Computational study of one aspect of autoresonant accelerator, 4:39400 (LA-UR—79-676)
Shank, K.E., *See* Oakes, T.W., 4:38875
Shankar, R., Weak discontinuities in magneto-gasdynamics with finite electrical conductivity, 4:39812
Shannon, J.D., *See* Sisterson, D.L., 4:39539
Shapira, D., *See* Maguire, C.F., 4:39902

Shapiro, A.M., Prediction of performance of a minimal storage passive solar house: the Crosley home, 4:38452 (CONF-780337—P3, pp 5p, Book 1, Paper 2)
Shapiro, G., *See* Lemaire, M.C., 4:39887
Sharp, D.H., Radiation reaction in nonrelativistic quantum theory, 4:39841 (LA-UR—79-357)
Sharp, D.J., Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
Sharp, M.K., Stratified thermal storage in residential solar energy applications, 4:38504 (COO—4523-1)
Shaw, J., Status of Laddertron development at HVE, 4:39373 (LA—7445-C, pp 237-240)
Shaw, R.A., Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
Shearer, M.N., *See* King, L.D., 4:39657
Sheen, S.H., *See* Carey, W.M., 4:38698
Sheheen, N.N., *See* Edeskuty, F.J., 4:38622
Sheih, C.M., Experimental determination of probe-length requirements for studies of the turbulent wake behind a cylinder, 4:39511
Sheindlin, A.E., Development of the MHD method of energy conversion in the U.S.S.R., 4:38945 (CONF-781009—, pp 85-104)
Results of the first phase tests of the U-25B facility, 4:38953 (CONF-781009—, pp 25-58)
Sheinker, A.A., *See* Kortovich, C.S., 4:39135
Sheldahl, R.E., Boron nitride ablation studies in arc jet facilities, 4:39179 (SAND—79-0413C)
Shelpuk, B., Proceedings of the desiccant cooling conference of November 16, 1977, 4:38481 (SERI—22)
Shen, M., *See* Yang, R.T., 4:38608
Shen, S.Y., *See* Bhattacharya, S., 4:39193, 4:39194
Shen, Y.R., *See* Bischofberger, T., 4:39513
Shenton, L.R., New algorithm for summing divergent series. Part 3. Applications, 4:40047
Sherden, D.J., *See* Prescott, C.Y., 4:39870
Sherman, J.D., Study of a 90° bending magnet for H^- beams, 4:39405 (LA-UR—79-710)
See Dytman, S.A., 4:39896
Sherman, P.L., Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB—286485)
Shewchun, J., *See* Singh, R., 4:38395
Sheybany, S., *See* Douglass, D.L., 4:38068
Shida, I., Geothermal survey with infrared radiation thermometer and thermister thermometer- Namekawa Spa and Ubayu Spa, 4:38522
Shidlovskiy, A.K., *See* Bystry, A.I., 4:38979
Shimanuki, K., *See* Matsumoto, S., 4:39329
Shimp, N.F., *See* Griffin, R.A., 4:39598
Shinkevich, G.G., Modified calculation of pressures on the casing in sloped boreholes, 4:38153
Shippee, P., Sunearth home, 4:38435 (CONF-780337—P2, pp 3p, Book 2, Paper 4)
Shirazi, M.A., Cooling tower plume research U.S. Environmental Protection Agency, 4:39589
Shirley, D.A., *See* Denley, D., 4:39158
See Perfetti, P., 4:39954
Shopf, A., U-type steam generators for nuclear power plants and their manufacture, 4:38630 (AED-Conf—78-155-006)
Shotov, A.P., *See* Gureev, D.M., 4:39309
Shpak, M.T., *See* Il'chishin, I.P., 4:39312
Shpatakovskaya, G.V., Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans—11471)
Shralbman, V.I., *See* Matusevich, A.V., 4:39722
Shumaker, R.C., Analysis of the structural parameters that influence gas production from the Devonian shale. Volume 1. Executive Summary and Task Reports. Annual progress report, 4:38177 (ORO—5194-2(Vol.1))
Shumiatsky, B.Y., *See* Sheindlin, A.E., 4:38945
Shupe, M.A., *See* Kirk, T.B.W., 4:39825
Siambis, J., *See* Lockner, T., 4:39388
Sidnev, V.V., *See* Shinkevich, G.G., 4:38153
Siemens, D.H., *See* Larson, D.E., 4:38255
Siems, P.L., Uranium potential and geology of the Challis Volcanics of the Basin Creek-Yankee Fork Area, Custer County, Idaho. Final report, 4:38206 (GJBX—33(79))
Sighicelli, S., *See* Bernard, P., 4:38635
Sigmar, D.J., Anomalous alpha-particle transport in thermonuclear tokamak plasma, 4:39982
Sikka, V.K., *See* McEnerney, J.W., 4:38686
Silva, C.Z., *See* Seila, A.F., 4:38938
Silver, G.L., Adsorption of neptunium and plutonium on metal phosphites, 4:38252 (MLM—2595)
Silverman, L.P., *See* Lave, L.B., 4:38874
Simmons, L.M. Jr., *See* Nieto, M.M., 4:39802
Simmons, R.R., Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
Simonsen, R.H., Integrated safeguards information system (ISIS). Executive summary. Technical report, 4:38293 (PB—286869)
Simpkins, J.E., Residual gas analysis in the ISX-A tokamak, 4:40026
Simpson, C.E., *See* Ratzel, A.C., 4:38499
Singer, J., *See* Fielder, W.L., 4:38849
Singh, C.M., Low-frequency fluctuation spectra and associated particle transport in the NASA Lewis Bumpy-Torus plasma, 4:39997 (N—78-30944)
Singh, R., Effect of grain boundaries on the performance of polycrystalline tunnel MIS solar cells, 4:38395
See Johnson, T.R., 4:38962
Sinha, S.K., Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
Sinnamon, J.F., Influence of overall fuel—air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine, 4:39071
Sipe, N.G., Historic and current energy analysis of Florida, 4:38861 (DOE/TIC—10108)
Sirito, F., *See* Martini, M., 4:39488
Sislian, J.P., Analysis of turbulent free jet hydrogen-air diffusion flames with finite chemical reaction rates. Final report, 4:38311 (N—78-30551)
Sisterson, D.L., Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants, 4:39539 (ANL/RER—78-2)
Sistla, G., *See* Rao, S.T., 4:39558
Sites, J.R., Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977—September 1978, 4:38370 (COO—4546-5)
Sitte, R., *See* Franzen, L.F., 4:38764
Sivers, D., *See* Babcock, J., 4:39867
See Hidaka, K., 4:39868
Skalski, B., *See* Halawa, T., 4:38615
Skeath, P.M., *See* Lindau, I., 4:39953
Skowronski, R.P., Deuterium tracer method for investigating the chemistry of coal liquefaction. Quarterly technical progress report, April—June 1978, 4:38076 (FE—2781-3)
Skriba, M.C., State-of-the-art survey of pneumatic powder transport, 4:38233 (WCAP—9189)
Slansky, R., Mechanisms of proton stability and decay in unified models, 4:39863 (LA-UR—79-361)
Slatkin, D.N., Genetic hazard of ^3H: estimation by oocyte uptake of ^3H, 4:39692 (BNL—25910)
Slimak, M., *See* Crumrine, K., 4:39596
Sloan, M.L., *See* Thompson, J.R., 4:39430
Slonaker, J.F., *See* Buttermore, W., 4:38118
Smalley, W.M., *See* Forrest, L., 4:39056
Smil'gyavichyus, V., *See* Birmontas, A., 4:39307
Smilansky, U., *See* Stokstad, R.G., 4:39911
Smirnova, E.A., *See* Demidov, B.A., 4:39395
Smith, A., Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region, 4:39909 (ANL/NDM—46)
See Paciotti, M., 4:39453
Smith, C.C., Solar supplement to laundry drying. Annual progress report, October 31, 1977—October 31, 1978, 4:38486 (COO—4517-1)
Smith, E.B., *See* Kirk, T.B.W., 4:39825
Smith, G.F., Techniques for mixing dispersants with spilled oil. Final report 1976, 4:38170 (PB—285679)
Smith, G.J., *See* Casten, R.F., 4:39908
Smith, G.R., *See* DiGiacomo, N.J., 4:39907
Smith, H.G., Observation of superstructure in α—U near 43 K, 4:39102 (CONF-790341—1(Draft))
See Wakabayashi, N., 4:39190
Smith, H.M., *See* Arnold, C. Jr., 4:39191
Smith, I.J., NS Otto Hahn: operational chemistry of the primary and secondary circuits, 4:38787
See Reinhardt, K.H., 4:38786
Smith, J., *See* Hooper, A.T., 4:38710
Smith, J.N. Jr., *See* Meyer, C.H. Jr., 4:39148
Smith, K.D., Operation of an anaerobic digester at the Washington State Dairy Farm, 4:38321
Smith, L., *See* Dukler, A.E., 4:38814
Smith, M.C., Future of hot dry rock geothermal energy systems, 4:38548 (LA-UR—79-683)
Smith, M.F., Boiler corrosion (citations from the NTIS data base). Report for 1964-August 1978, 4:38582 (NTIS/PS—78/0993)
Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76, 4:38583 (NTIS/PS—78/0994)
Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76, 4:38584 (NTIS/PS—78/0994/SL)
Boiler corrosion. volume 3. 1977-august, 1978 (citations from the engineering index data base). Report for 1977-August 1978, 4:38585 (NTIS/PS—78/0995)
Smith, R.P., Observation of voltage fluctuations in a superconducting magnet during MHD power generation, 4:38958 (CONF-780952—24)
Smith, T.H., Evaluations of alternatives for management of INEL transuranic waste, 4:38248 (CONF-790602—30)

Smoot, L.D., Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 6, 1 July 1978—30 September 1978, 4:38067 (TID—28953)
Smyrl, W.H., Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND—79-0246C)
Experimental application of design principles in corrosion research, 4:39183
Snow, R., *See* Bridges, J., 4:38195
Snyder, B., *See* Longley, W.L., 4:38163
Snyder, H.D., *See* Vidal, R., 4:39828
Snyder, N.W., *See* Wilson, E.M., 4:39047
Sobel, J., Fair allocations of a renewable resource. Research report, 4:38908 (AD-A—057953)
Sobell, H.M., *See* Friedman, L.R., 4:39659
See Lozansky, E.D., 4:39637
See Reddy, B.S., 4:39245
See Sakore, T.D., 4:39244
Sober, D.I., *See* Nefkens, B.M.K., 4:39827
Sobral, J.H.A., Various measurements of atmospheric parameters from incoherent scattering of nightglow, 4:39764 (N—78-30753)
Sokol'sky, A.G., *See* Pishchikov, S.I., 4:38954
Sokolov, Yu.N., *See* Gokhstein, Ya.P., 4:38978
Sokolova, L.V., *See* Burakov, V.S., 4:39975
Sokolovsky, A., *See* Berriaud, C., 4:38793
Solarz, R.W., Laser induced fluorescence studies of the reactions of barium (^{1}S, ^{3}D) and strontium (^{1}S, ^{3}P) with halogenated methanes, 4:39251
Solbes, A., *See* Cole, J., 4:38975
Solell, Y., Wave motor, 4:38559
Solin, S.A., Amorphous carbon and its structural relationship to amorphous silicon and germanium, 4:39952
Solomon, J.E., Electro-optical detection of uranium-238 decay products in the atmosphere. LIDAR remote sensing techniques are studied to determine effectiveness in detecting uranium ore. Final report February 1976-January 1978, 4:38205 (AD-A—057797)
Sondheim, W., *See* Lund, T.S., 4:39427
Soo, S.L., *See* Reiber, M., 4:38114
See Rieber, M., 4:38110, 4:38111, 4:38112, 4:38113, 4:38115, 4:38116, 4:38117
Sorba, P., *See* Matveev, V.A., 4:39857
Sorensen, C., Rescattering corrections to spin-dependent proton-deuteron total cross sections, 4:39866
Soukas, A., *See* Weng, W.T., 4:39429
Sowada, U., Laser photodetachment of electrons from O_2^- in nonpolar liquids), 4:39250
Spaepen, G.J.P., *See* Blanchart, A.P.O., 4:38858
Spalaris, C.N., Welding for the CRBRP steam generators, 4:38667 (GEFR-SP—151)
Spangler, D., Development of basis sets for molecular calculations. Comparison of tetrahedral Gaussian lobe functions and Cartesian Gaussian basis sets, 4:39804
Sparks, D.T., *See* Cook, B.A., 4:38797
Speicher, H.W., Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15—August 30, 1978, 4:38043 (COO—4748-1)
Spence, J., Simplified methods for piping analysis in the creep regime, 4:38749
Spencer, A.G., High voltage dc for resource development, 4:38620
Spencer, S.G., 1978 annual report, INEL geothermal environmental program, 4:38530 (TREE—1340)
Sperber, D., *See* Huizenga, J.R., 4:39932
Spicer, D.S., The primary energy release in reconnection flare models. Interim report, 4:39743 (AD-A—058325)
Spicer, W.E., *See* Lindau, I., 4:39953
Spiller, L.L., *See* Hitchcock, D.R., 4:39563
Spiridonov, E.G., *See* Telegin, G.P., 4:38967
Spragle, P., *See* Adler, R., 4:39382
Sprangle, P., Theory of the cyclotron maser instability, 4:39336 (CONF-771035—P2, pp 703-716)
See Granatstein, V.L., 4:39333
Sprengel, D., Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT—78-20)
Sprott, J.C., *See* Strait, E.J., 4:40012
Stabinis, A., *See* Birmontas, A., 4:39307
Stamper, K.R., *See* Chamberlain, T.W., 4:39065, 4:39066
See Koehler, D.E., 4:39067
See Marshall, W.F., 4:38983
Stanfield, Z.A., Apparatus and method for drying seed corn by burning cobs, 4:39037
Stanko, J.J., Fireplace systems, 4:39006
Stanley, N.E., *See* Spencer, S.G., 4:38530
Stannard, F.R., *See* Read, A.L., 4:39821
Stansberry, C.L., EMP, lightning, and power transients: their threat and relationship to future EMP standards. Technical note, 4:39501 (AD-A—058404)
Stapenhorst, F.W.E., Ossberger cross-flow turbine, 4:38335
Star, J.L., Horizontal undependability in the planktonic environment, 4:39610
Starodubrovskaya, S.P., *See* Berzon, I.S., 4:39713
Starr, G., Soldyne house, 4:38434 (CONF-780337—P2, pp 7p, Book 2, Paper 3)
Start, G.E., Rancho Seco building wake effects on atmospheric diffusion. Technical memo, 4:38763 (PB—285165)
Stauning, P., Compilation of ionlab riometer data for IMS workshop in Hankasalmi, 4:39763 (N—78-28732)
Stawsky, A., *See* Rosynsky, V., 4:39081
Stechemesser, H., *See* Krug, W., 4:38677
Stecker, F.W., Diffuse fluxes of cosmic high energy neutrinos, 4:39730 (N—78-31040)
Steele, B.R., *See* Ballard, C.P., 4:39518
Stehney, A.F., Survival times of women radium dial workers first exposed before 1930, 4:39674 (ANL—78-65(Pt.2), pp 8)
See Rowland, R.E., 4:39673
Steinberg, E.P., *See* Kaufman, S.B., 4:39901
See Wilkins, B.D., 4:39924
Steinberg, M., Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP, 4:38225
Steinbruechel, C., Application of matrix isolation spectroscopy to the measurement of sputtering yields, 4:39098
Desorption kinetics of one- and two-step mechanisms, 4:39232
Steiner, H., *See* Lemaire, M.C., 4:39887
Steiner, R.R., Catalytic control of NO/sup x/ demonstration. Final report, 4:39088 (PB—284095)
Steininger, D.A., *See* Hetsroni, G., 4:38736
Steinmetz, L.L., Picosecond photodetector for 257 nm to 1 μm laser pulses, 4:39296
Stengel, D.N., Descriptor analysis of economic systems, 4:38870 (TID—29393)
See Cline, T.B., 4:38864
Stenhouse, D.S., Daylighting design for the Sacramento State Office Building Competition, 4:38428 (CONF-780337—P1, pp 6p, Book 3, Paper 4)
Stensland, G.J., Comparison of precipitation chemistry data at a central Illinois site in 1954 and in 1977, 4:39541 (COO—1199-54)
Stepanov, V.P., Use of combined geophysical studies for investigating the tectonics of the crystalline basement of western regions of the Russian platform, 4:39712
Stephenson, J., *See* Shaw, R.A., 4:39007
Stetz, A., Determination of the axial vector form factor in the radiative decay of the pion, 4:39847
Stevens, R.K., *See* Mulik, J.D., 4:39560
Stevie, R.G., *See* Goddard, H.C., 4:39052
Stewart, J.E., *See* Hsue, S.T., 4:38239
Stewart, L., Summary documentation for ^{1}H, 4:39881 (LA—7663-MS, pp 4-14)
Summary documentation for ^{3}He, 4:39882 (LA—7663-MS, pp 21-25)
See Hale, G.M., 4:39892, 4:39893
Stewart, R.G., *See* Halliday, L.A., 4:39030
Stewart, W.B., *See* Lacy, C.S., 4:38650
Stimetz, C.J., Pulse plating of hard gold electrodeposits, 4:39101 (BDX—613-2165)
Stirling, W.L., Properties of an intense 40-kV neutral beam injector, 4:40011
Stock, L.L., Coal anion structure and chemistry of coal alkylation. Sixth quarterly progress report, June 1—August 31, 1978, 4:38083 (COO—4227-6)
Stodiek, W., *See* Bitter, M., 4:39973
Stoehr, J., *See* Denley, D., 4:39158
Stoelben, H., *See* Dio, W.H., 4:38629
Stoering, J.P., X-ray reflectivity vs mirror surface quality, 4:39960 (UCID—18030)
Stokes, B.O., Assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation, 4:38324 (N—78-30798)
Stokes, R.H., Rf quadrupole beam dynamics, 4:39408 (LA-UR—657)
Stokstad, R.G., Effect of nuclear deformation on heavy-ion fusion, 4:39911 (INIS-mf—4427, pp 22)
Stoltz, R.E., Solid metal embrittlement of Ti—6Al—6V—2Sn by cadmium, silver and gold, 4:39129
Stolzenbach, K.D., *See* Harleman, D.R.F., 4:39623
See Pollack, A.M., 4:39617
Stone, I.Z., *See* Karnesky, R.A., 4:38671
Stone, P., High-beta tokamak research. Quarterly status report, 1 October—31 December 1978, 4:39971 (COO—2456-76)
Storey, J.W.V., The potential for astrometry in the infrared, 4:39734 (N—78-31017)
Stovall, J.E., Initial performance of the PIGMI prototype, 4:39448 (LA-UR—79-658)
See Stokes, R.H., 4:39408
Strachan, J.D., Neutron emission profiles in the beam-heated Princeton large tokamak, 4:39977
Strain, R.V., Results of UO_2 diagnostic tests for run beyond cladding breach in EBR-II, 4:38661 (ANL—78-99)
See Washburn, D.F., 4:38670
Strait, E.J., Experimental test of the feasibility of heating tokamaks by gun injection, 4:40012
Stralt, J., *See* Claudson, M., 4:39848
Strand, R.H., Environmental data: management and needs analysis considerations, 4:40050 (CONF-790146—1)
Stratmann, J., *See* Knappstein, H., 4:38088
Stratt, R.M., Semiclassical statistical mechanics of fluids: Nonperturbative

incorporation of quantum effects in classical many body models, 4:39807
Strauss, H.R., Twisting modes, 4:39991
Streatfield, R.E., Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
Streed, E.R., *See* Waksman, D., 4:38494
Strekalov, N.V., *See* Burenkov, D.K., 4:38974
Strelkov, P.S., Maser electron cyclotron resonance in vacuum and plasma with REB, 4:39337 (CONF-771035—P2, pp 717-728)
Strobel, M., *See* Knappstein, H., 4:38088
Stroem, L.H., In-place testing of monitors for airborne reactor effluents, 4:39489
Stroh, K.R., Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores, 4:38641 (LA—7709-T)
Stroik, P.J., *See* Grisham, D.L., 4:39451
Strom, S.S., *See* Dicks, J.B., 4:38950
Strother, L.W., *See* Beason, F.L., 4:38415
Strozier, J.A., Catalytic reactions on well characterized surfaces by ac techniques, 4:39223 (LBL—8975, pp 27.-28.)
Strumpf, H.J., Preliminary design study of an alternate heat source assembly for a Brayton isotope power system. Final report, October 1977—April 1978, 4:38306 (N—78-28608)
Struxness, E.G., *See* Auerbach, S.I., 4:39581
Stulen, R.H., *See* Stoltz, R.E., 4:39129
Stumpp, G., Fuel injection system, 4:39062
Styrikovich, M.A., Heat releases of power plants, 4:39592
Su, C.Y., *See* Lindau, I., 4:39953
Suaya, R., Quark fragmentation: Some simple tests for quantum chromodynamics, 4:39836
Subbotin, V.G., *See* Flerov, G.N., 4:39919
Suckewer, S., *See* Nishi, M., 4:40020
Sudan, R.N., *See* Ludwig, G.O., 4:39987
See Nation, J.A., 4:39439
Sugihara, K., *See* Emery, A.F., 4:39326
Sugimura, H., Process for liquefying coal, 4:38079
Suikov, V.V., *See* Evseev, G.S., 4:39718
Suitt, T., *See* Kapiloff, L., 4:38178
Sukhov, V.N., *See* Maslennikov, V.M., 4:38960
Sulak, L., *See* Weng, W.T., 4:39429
Sulak, L.R., *See* Claudson, M., 4:39848
Sullivan, J.F., *See* Spencer, S.G., 4:38530
Sullivan, P., *See* Anderson, B., 4:38420
Sullivan, T.J., Los Angeles senior citizen lifeline electricity rates, 4:38932 (RAND/R—2278-DWP/NSF)
Sumi, S., *See* Seikieka, M., 4:38549
Sundaram, M., *See* Kotrappa, P., 4:38770
Sung, R., *See* Cotter, J.E., 4:38199
Sunier, J.W., *See* Loehoeiden, G., 4:39913
Sunyar, A.W., *See* Baktash, C., 4:39912
Suratt, W.B., Study and testing of direct contact heat exchangers for geothermal brines. Phase II, August 1976—June 1977, 4:38542 (ORO—4893-2)
Susskind, L., *See* Fischler, W., 4:39875
Suta, B.E., Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB—285430)
Suzuki, S., *See* Lee, M.C., 4:38826
Svalgaard, L., The strength of the sun's polar fields, 4:39747 (N—78-29029)
See Schatten, K.H., 4:39746
Sventek, J., *See* Moretto, L.G., 4:39928
Swales, M.C., *See* Furst, G.B., 4:38555
Swanberg, C.A., *See* Gunaji, N.N., 4:38550
Swanson, C.R., *See* Bischoff, W.S., 4:38540, 4:38543
Sweeney, R.A., *See* Wyeth, R.K., 4:39537
Swegle, J.W., Anisotropic constitutive equation for use in finite difference wave propagation calculations, 4:39810 (SAND—79-0382)
Swenson, D.A., *See* Stokes, R.H., 4:39408
Sylvain, J.D., *See* Schneider, M., 4:38461
Symons, P.C., *See* Carr, P., 4:38844
Syniuta, W.D., *See* Hoagland, L.C., 4:38305
Szirmae, A., *See* Fisher, R.M., 4:38064

T

Taasevigen, D.K., Earth Sciences Division, collected abstracts, 1978, 4:39706 (UCRL—52681)
Tadikamalla, P.R., *See* Johnson, M.E., 4:40039
Taflove, A., *See* Bridges, J., 4:38195
Tager, S.A., *See* Joubert, J.I., 4:38968
See Maslennikov, V.M., 4:38960
Taglienti, S., *See* Biserna, T., 4:38691
Takagi, S., *See* Seikieka, M., 4:38549
Takahashi, H., *See* Steinberg, M., 4:38225
Takahashi, I., *See* Matsumoto, S., 4:39329
Takahisa, K., *See* Nomura, H., 4:39273
Talbot, R., *See* Guiffre, M.S., 4:38268
See Koplick, C.M., 4:38264, 4:38265, 4:38266, 4:38269
Taliaferro, R.C., Testing program for mining coal in an oxygen free atmosphere. Volume 1. Final report, 4:38103 (PB—285122)
Tallerico, P.J., Advances in high-power rf amplifiers, 4:39452 (LA-UR—79-705)
Talumaa, R.U., *See* Maslennikov, V.M., 4:38960
Tamura, T., Earth Sciences, 4:38087 (ORNL—5508, pp 92-101)
Tanabe, J., Doublet III neutral beam source cryopanel system, 4:40019 (LBL—8900)
Tanaka, K., *See* Kitazoe, T., 4:39869
Tanaka, M., *See* Cnops, A.M., 4:39819
Tang, S.Y., *See* Neynaber, R.H., 4:39788
Tanihata, I., *See* Lemaire, M.C., 4:39887
Tao, C., *See* Kirk, T.B.W., 4:39825
Tardiff, G.E., *See* Harrar, J.E., 4:38545
Taskhutdinov, R.A., *See* Gabdrakhmanov, A.G., 4:38156
Taylor, C.G., *See* Macleod, I.D., 4:38696
Taylor, G.A., *See* Carpenter, P.R., 4:38377
Taylor, G.M., X-ray microdensitometer (XRPD) performance characteristics, 4:39498 (UCRL—52657)
Taylor, P.A., Biological denitrification of industrial strength nitrate wastes, 4:39049 (Y/DA—8220)
Taylor, T.N., Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
Taylor, W.E., Array Automated Assembly, Phase 2. Quarterly report for the quarter ending June 30, 1978, 4:38372 (DOE/JPL/954853—3)
Array automated assembly. Phase 2: quarterly report for the quarter ending September 30, 1978, 4:38373 (DOE/JPL/954853—4)
Taylor, W.G., *See* Harless, C.E., 4:39266
Tchertkov, A.A., *See* Malutchkov, O.T., 4:39147
Teeple, R.V., *See* O'Hara, J.B., 4:38051
Tejpar, Z., *See* Bush, T.W., 4:38080
Telegin, G.P., Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142—1)
Telkes, M., Trombe wall with phase change storage material, 4:38457 (CONF-780337—P3, pp 5p, Book 2, Paper 2)
Tenenbein, A., *See* Johnson, M.E., 4:40038
Tenforde, T.S., *See* Gaffey, C.T., 4:39702
Teng, T., *See* Barbeau, D.L., 4:39643
Ter-Akop'yan, G.M., *See* Flerov, G.N., 4:39919
Terry, J., *See* Liljedahl, D.R., 4:39027
Terwilliger, K.M., *See* Crabb, D.G., 4:39434
Thambimuthu, K.V., *See* Doganoglu, Y., 4:39350
Thieberger, P., Comments on Coulomb explosion experience at Brookhaven, 4:39399 (LA—7445-C, pp 230)
Improved MP acceleration tube performance, 4:39374 (LA—7445-C, pp 241-248)
Major improvements at Brookhaven since the beginning, 4:39371 (LA—7445-C, pp 231-234)
Thiessen, H.A., *See* Dytman, S.A., 4:39896
Thigpen, L., Seismic monitoring: a unified system for research and verifications, 4:39714 (UCRL—52665)
Thode, E.F., *See* Gunaji, N.N., 4:38550
Thom, K., *See* Schneider, R.T., 4:38788
Thompson, G.H., *See* Navratil, J.D., 4:38241
Thompson, H.W., Reclamation and reuse of fruit processing wastewater, 4:39043 (PB—283694)
Thompson, J.F., *See* Sha, W.T., 4:38684
Thompson, J.R., Limiting currents for injection of an unneutralized magnetized relativistic electron beam into a cylindrical drift tube, 4:39430 (CONF-771035—P2, pp 729-740)
Thompson, M., *See* Dris, M., 4:39826
Thompson, P.A., *See* Bowman, J.D., 4:39818
Thompson, W.T., Shallow land burial - why or why not, 4:38261 (CONF-790331—3)
Thorn, L.L., *See* Agnew, L., 4:39450
Thorn, R.J., *See* Murch, G.E., 4:39105
Thornton, J.A., *See* Jonath, A.D., 4:39188
Thornton, R.K., *See* Kirk, T.B.W., 4:39825
Thorsheim, I., Wave power generator, 4:38558
Thorson, L.D., *See* Hanson, M.E., 4:38181
Thurston, B.E., *See* Turiel, I., 4:39010
Tichenor, B.A., *See* Shirazi, M.A., 4:39589
Tierney, M.S., Estimating probabilities of disposal system failure - A status report, 4:38281
See Ellingson, A.C., 4:39704
Tikhonov, E.A., *See* Il'chishin, I.P., 4:39312
Tikhotsky, A.S., *See* Burenkov, D.K., 4:38974
Tishchenko, V.G., *See* Il'chishin, I.P., 4:39312
Tishkin, V.F., *See* Goloviznin, V.M., 4:39809
Tobias, C.A., *See* Alonso, J.R., 4:39459
Todreas, N.E., Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1978—August 31, 1978, 4:38663 (COO—2245-65)
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1978—November 30, 1978, 4:38664 (COO—2245-66)
Tolchinskii, L.S., *See* Vasil'eva, I.A., 4:38981
Tolkachev, V.A., Relation of the average energy of complex molecules combining by absorption and emission, 4:39320
Tollestrup, A., *See* Fung, S., 4:39455
Tomashov, V.N., *See* Bashkin, A.S., 4:39318
Tomozawa, Y., Comment on the magnetic moments of baryons in the broken-SU(6) -symmetry model, 4:39871
See Levine, R., 4:39839
Toohey, R.E., Field measurements of radium in the human body, 4:39681 (ANL—78-65(Pt.2), pp 111-117)

Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL—78-65(Pt.2), pp 155-162)
See Essling, M.A., 4:39689
Toon, O.B., *See* Hamill, P., 4:39577
Torstrick, R.L., *See* Bucy, J.I., 4:39045
Tortorelli, P.F., Sputtering of two-phase polycrystalline metals, 4:39777
Tosi, V., *See* Biserna, T., 4:38691
Tosunov, E.M., Use of polymers for isolating flows of impure water, 4:38149
Toth, L.M., Photochemistry of the actinides, 4:39253 (CONF-790415—21)
Toussaint, D., Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
Tovee, D.N., *See* Read, A.L., 4:39821
Towle, D.M., *See* Huba, J.D., 4:39761
Towner, H.H., *See* Strachan, J.D., 4:39977
Townley, C.H.A., Design rules for high temperature plant - the implications of recent research in relation to current practice, 4:38681
Townsend, J.S., *See* Suaya, R., 4:39836
Toy, H.D., *See* Sherman, P.L., 4:39571
Trainer, F.W., Geohydrologic data from the Jemez Mountains and vicinity, north-central New Mexico. Final report, 4:38513 (PB—284221)
Tran, D.Q., Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1—June 30, 1978, 4:38063 (FE—2806-1)
Trauth, C.A. Jr., *See* Ellingson, A.C., 4:39704
Treiman, S.B., *See* Toussaint, D., 4:39737
Triezenberg, D.M., *See* Carroll, D.P., 4:38610
Triplett, M.B., *See* Denning, R.S., 4:38942
Troia, E., Hybrid solar greenhouse at Cate farm, 4:38446 (CONF-780337—P2, pp 5p, Book 3, Paper 2)
Tronov, A.P., *See* Muslimov, R.Kh., 4:38198
Trott, W.M., Photoionization mass spectrometric studies of selected compounds in a molecular beam, 4:39793 (LA—7727-T)
Truett, J.B., *See* Kenkeremath, D.C., 4:39562
Trujillo, R.E., *See* Arnold, C. Jr., 4:38480
Truong, T.N., *See* Deshpande, N.G., 4:39858
Trutt, F.C., *See* Morley, L.A., 4:38131
Trygg, G.D., *See* Goddard, H.C., 4:39052
Tsai, C.C., *See* Phani, M.K., 4:39949
See Stirling, W.L., 4:40011
Tsang, F.Y., Doppler effect measurements on solid and liquid Sn, 4:39910 (CONF-790602—41)
Tsang, J.S.K., One- and two-dimensional heating analyses of fusion synfuel blankets, 4:40005 (BNL-NUREG—25635)
Tserruya, I., *See* Stokstad, R.G., 4:39911
Tsong, I.S.T., Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
Tsuda, S., *See* Yorozu, M., 4:38511
Tubbs, L.E., *See* Huizenga, J.R., 4:39932
Tuddenham, W.S., Planning guide for radiologic installations -- fascicle ha, basic concepts, layout considerations, 4:39654 (HRP—0900241)
Tuller, B.H., *See* Casey, G.L., 4:39068
Tully, F.P., The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A—059809)
Tung, C.J., *See* Ashley, J.C., 4:39939
Turck, B., Energy losses in a flat transposed cable, 4:38621 (LA—7635-MS)
Losses in superconducting multifilament composites under alternating changing fields, 4:39270 (LA—7639-MS)
Turco, R.P., *See* Hamill, P., 4:39577
Turcotte, L.R., *See* Nyilas, E., 4:39652
Turiel, I., Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL—8893)
See Hollowell, C.G., 4:38995
Turkevich, J., Supported catalysts: synthesis and characterization, 4:39227 (LBL—8975, pp 55.-57.)
Turner, J.E., *See* Gammage, R.B., 4:38130
Turner, R.K., *See* Coutts, H.J., 4:39079
Tyndall, R., *See* Coulson, P.B., 4:39647
Tyndall, R.L., *See* Davidson, K.A., 4:39648

U

Ueland, M., Solar atrium: a hybrid solar heating and cooling system, 4:38423 (CONF-780337—P1, pp 5p, Book 2, Paper 3)
Uellner, W., Electric generator development for the 1980's. Final report July 1975—April 1978, 4:38581 (AD-A—057448)
Ueno, K., *See* Vidal, R., 4:39828
Uhm, H.S., High intensity electron beam propagation between two plane conductors and its implications for collective ion acceleration, 4:39379 (AD-A—059337)
Ulehla, M.V.K., *See* Wendelken, J.F., 4:39149
Ullman, D.G., Variable inertia flywheel as an energy storage system, 4:38835
Ulrich, W.C., *See* Edwards, M.S., 4:38047
Underwood, D.R., *See* Dyer, N.C., 4:38633
Unny, T.E., *See* Hollands, K.G.T., 4:38495
Upton, T.H., Theoretical studies of nickel clusters and chemisorption of hydrogen, 4:39151
Urbenajo, R., *See* Lansing, F.L., 4:38996
Uresk, D.W., Diets of mule deer within steppe vegetation of south central Washington, 4:39606 (BNWL-SA—6532)
Uresk, V.A., *See* Uresk, D.W., 4:39606
Uri, N.D., *See* Maybee, S., 4:38933
Urinson, A.S., *See* Vasil'eva, I.A., 4:38981
Urnezis, P.W., *See* Holtzman, R.B., 4:39600
Uspenskaya, G.L., *See* Burenkov, D.K., 4:38974

V

Vahala, G., Stable equilibrium statistical states for spheromaks, 4:39989
Vahala, L., *See* Vahala, G., 4:39989
Van Arsdall, R.T., Energy policies: Price impacts on the U.S. food system. Final agricultural economic report, 4:38868 (PB—285869)
van Dam, A., Energy saved is cheaper than energy generated, 4:38905
Van Dam, H., Reactivity effects and space-domain noise caused by randomly dispersed materials in a reactor core, 4:38728
Van den Avyle, J.A., *See* Gauster, W.B., 4:39128
Van der Meer, S., Stochastic cooling theory and devices, 4:39410 (LBL—7574, pp 73-77)
Van Duyn, K., *See* Mazria, E., 4:38445
van Dyck, O.B., Medium-energy physics program. Quarterly report, May 1—July 31, 1978, 4:39377 (LA—7650-PR) 800-MeV spin precessor for polarized H^- beams using H^- to H^0 stripping, 4:39407 (LA-UR—79-751)
See Macek, R.J., 4:39406
Van Hook, R.I., Ecosystem Studies Program, 4:39615 (ORNL—5508, pp 24-35)
van Ommering, G., Overchargeable sealed metal oxide/lanthanum nickel hydride battery, 4:38986
van Rooyen, D., *See* Agrawal, A.K., 4:38812
van Steenbergen, A., *See* Krinsky, S., 4:39468
Van Tran, T., *See* Markind, J., 4:38253
van Vliet, J., Short terms experiments in BR2 towards a better fast fuel performance analysis, 4:38675 (INIS-mf—4426, pp VII.1-20)
Van Wie, N.H., Description of data entry for automated cost estimating, 4:40035 (K/CSD/TM—29)
Van Zant, G., Competition between erythropoietin and colony-stimulating factor for target cells in mouse marrow, 4:39640
See Eliason, J.F., 4:39639
Vanderpol, A.H., *See* Charlson, R.J., 4:39536
Vane, C.R., *See* Elston, S.B., 4:39798
Vanmassenhove, G., *See* Hebel, W., 4:38782
See Kramer, W., 4:38803
See Krug, W., 4:38677
Vannice, M.A., Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL—8975, pp 25.-26.)
VanWanderham, M.C., Low cycle fatigue behavior of IN-100: strainrange partitioning method, 4:39137
Vanyan, L.L., *See* Dyal, P., 4:39760
Vasan, S., Process for pressure stripping of sulfur dioxide from buffered solutions, 4:39357
Vaseen, V.A., Separating gaseous nitrogen oxides from other gases by paramagnetic separation in a liquid media, 4:39354
Vashi, V.D., *See* Kotrappa, P., 4:38770
Vasil'eva, I.A., Development of working fluid diagnostics for large MHD generators by means of submillimeter lasers, 4:38981 (CONF-781009—, pp 801-823)
Vasiliev, O.F., Three-dimensional numerical model for hydrothermal analysis of cooling ponds, 4:39628
Two-dimensional numerical models for hydrothermal analysis of water bodies, 4:39629
Veldre, I.A., Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr—138)
Velikanov, A.G., *See* Bashkin, A.S., 4:39317
Velthuys, B.V., *See* Kok, B., 4:39555
Veneruso, A.F., Technology development for high temperature logging tools, 4:38527 (SAND—79-0013C)
Verbeck, S.L., *See* Dytman, S.A., 4:39896
Vereecke, F.J., *See* Hemsath, K.H., 4:39345
Versaw, E.F., *See* Brewer, G.D., 4:39017, 4:39018
Vidal, R., Search for new massive particles, 4:39828
Viecelli, J.A., Wave resistance in a rotating liquid layer, 4:39327 (UCRL—82436)
Vigneron, F.R., Plan for flight evaluation of attitude stabilization and flexible solar array dynamics for the Communications Technology Satellite, 4:38396
Vilain, P., *See* Read, A.L., 4:39821
Villa, F., *See* del Papa, C., 4:39816
Vindelov, K.E., *See* Armantrout, G.A., 4:38394

Vineberg, E.J., *See* Douglass, D.L., 4:38068
Viola, V.E. Jr., *See* Dyer, P., 4:39925
See Moyle, R.A., 4:39895
Vitkovitsky, I.M., Inductive storage for high power REB accelerators, 4:39440 (CONF-771035—P2, pp 857-868)
Vittitoe, C.N., *See* Biggs, F., 4:38496
Vogt, K.J., *See* Heinemann, K., 4:38768
Vogt, S., *See* Bayer, A., 4:38824
Volframs, A., *See* Perry, N.R.F., 4:39025
Vollerin, B., *See* Baumgartner, H., 4:39349
Volovik, A.V., High temperature air preheaters for a commercial scale MHD power plant, 4:38961 (CONF-781009—, pp 485-500)
von Benda, K., Galvanic cell having rechargeable zinc electrode, 4:38853
von Goeler, S., *See* Bitter, M., 4:39973
Von Halle, E., *See* Blumkin, S., 4:38290
Voronin, V.S., *See* Kolomensky, A.A., 4:39396
Vreke, J., *See* Nowack, H., 4:39140
Vuataz, F.D., Development of geothermal energy in Japan, 4:38517
Vysotsky, D.A., *See* Telegin, G.P., 4:38967

W

Wach, D., *See* Dio, W.H., 4:38629
Wachniack, R., Contribution from U.S. system suppliers to the power generating industry, 4:38732 (AED-Conf—78-048-003)
Wachter, R.A., *See* Blackwood, T.R., 4:38092
Wada, N., *See* Solin, S.A., 4:39952
Wada, W.W., *See* Aubrecht, G.J. II, 4:39851
Waddell, B.V., Nonlinear interaction of tearing modes in highly resistive tokamaks, 4:39992
Waddell, J.D., *See* Denning, R.S., 4:38942
Waddington, J.C., *See* Scarlett, W.R., 4:39729
Wade, W.H., *See* Schechter, R.S., 4:38138
Wadlinger, E.A., Stable particle motion in a linear accelerator with solenoid focusing, 4:39403 (LA-UR—79-701)
Waggoner, A.P., *See* Charlson, R.J., 4:39536
Wagner, E.P., *See* Johnson, C.E., 4:38289
Wagner, J.A., *See* Jellison, J.L., 4:39093
Wagner, P., *See* Wewerka, E.M., 4:38202
Wagschal, J.J., *See* Reiss, Y., 4:38721
Waibel, R.T., Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 2, Kiln Burner, 4:38123 (FE—2489-27)
Wakabayashi, N., Phonons and charge density waves in 1T-$TiSe_2$, 4:39190
See Smith, H.G., 4:39102
Wakalopulos, G., High peak power pulsed WIP electron gun. Final report, 1 April—1 October 1978, 4:39773 (UCRL—13950)
Waksman, D., Provisional flat plate solar collector testing procedures: first revision. Interim report, 4:38494 (PB—283721)
Walker, W.L., Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC—24143)
Walkup, R.E., *See* Larsen, R.P., 4:39199
Wall, K.D., *See* Cline, T.B., 4:38864
Wallace, C.J., *See* Stokes, B.O., 4:38324
Wallace, R.M., *See* VanWanderham, M.C., 4:39137
Wallace, T.F., *See* Negri, J.M., 4:39070
Wallhagen, R.E., A fire retardant froth foam seal topping system for the USBM remote mine sealing system. volume I. Final report Jun 75-Aug 77, 4:38104 (PB—286988)
Walsh, J.P., *See* Yeghiayan, R.P., 4:39524
Walton, F.B., Optimization of decontamination strategy for CANDU-PHW reactors, 4:38659
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
Waltz, R.E., Maximum energy-confinement time in Joule-heated tokamaks, 4:39969
Walvekar, A., *See* Gunaji, N.N., 4:38550
Wampler, W.R., Hydrogen isotope trapping in materials exposed in PLT, 4:40006 (PPPL—1537)
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND—79-0727C)
See Gauster, W.B., 4:39128
Wanek, P.I., *See* Wewerka, E.M., 4:38202
Wang, C.L., *See* Stoering, J.P., 4:39960
Wang, C.Y., Analysis of nonlinear fluid structure interaction transient in fast reactors, 4:38790 (ANL—78-103)
Wang, J.H.S., *See* Mastrup, F.N., 4:39298
Wang, J.M., *See* Courant, E.D., 4:39470
Wang, L.C., *See* del Papa, C., 4:39816
Ward, D.B., *See* Melnick, G., 4:39732
Ward, D.S., Role of mathematical modeling in low-level radioactive waste management, 4:38260 (CONF-790331—2)
Ward, R., Control of self-advancing mine roof supports, 4:38105
Warnick, C.C., Potential for hydroelectric development in existing irrigation systems, 4:38330
See Gladwell, J.S., 4:38325
Warren, C., *See* Kapiloff, L., 4:38178
Warren, R., Tests of vacuum interrupters for the Tokamak Fusion Test Reactor, 4:40009 (LA—7759-MS)
Warwick, J.W., *See* Kaiser, M.L., 4:39757
Wasan, D.T., *See* Gidaspow, D., 4:38072
Washburn, D.F., Mixed oxide run-beyond-cladding-breach tests in EBR-II, 4:38670 (HEDL-SA—1536-FP)
Washington, L.J. Jr., Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, July—September 1978, 4:38191 (FE—2346-34)
Wasson, O.A., Neutron flux monitoring and data analysis for neutron standard reaction cross sections, 4:39943
See Lamaze, G.P., 4:39897
Watanabe, K., *See* Baba, K., 4:38536
Watanabe, T., A new treatment of localized modes in inhomogeneous Vlasov plasma, 4:39996 (N—78-27915)
Watari, T., Radio-frequency plugging of a high density plasma, 4:39964 (N—78-27916)
Watson, D., Beyond passive design: toward an integrative conservation technology, 4:38421 (CONF-780337—P1, pp 6p, Book 2, Paper 1)
Watters, R.W., *See* Gillies, J., 4:38382
Wawersik, W.R., Interim summary of Sandia creep experiments on rock salt from the WIPP study area, southeastern New Mexico, 4:39727 (SAND—79-0115)
Weaver, M.J., *See* Harrison, G.F., 4:39139
Weaver, P., Photobiological production of hydrogen: a solar energy conversion option, 4:38309 (SERI/TR—33-122)
Weaver, T.A., Evolution and explosion of massive stars, 4:39736 (UCRL—82057(Rev.1))
Webb, W.L., Development of an improved methane sampling system. Open file report, 4:38132 (PB—286006)
Weber, J.W., HEDL mixed oxide fuel pin breach experience in EBR-II, 4:38669 (HEDL-SA—1535-FP)
Weddigen, G., *See* Fischer, W., 4:38851
Wehner, A.S., *See* Kerwin, D.K., 4:38796
Wei, P.S.P., *See* Adamski, J.L., 4:39381
Weil, R., Apparatus for sectioning diffusion specimens in liquid nitrogen, 4:39512
Weil, S.A., *See* Tran, D.Q., 4:38063
Weinberg, A.M., Energy policy and mathematics, 4:38917 (ORAU/IEA—79-5(0))
Weinkoetz, G., *See* Krebs, L., 4:38694
Weis, J., *See* Brodsky, S.J., 4:39842
Weis, P., Status of information for consumers of small wind energy systems, 4:38563 (SERI/TP—51-158)
Weisfield, M.W., *See* Kaufman, S.B., 4:39901
Weisman, H., *See* Earley, R.F., 4:38360
Weiss, F.P., *See* Grabner, A., 4:38637
Weiss, R.S., *See* Downing, R.G., 4:38387
Weissenburger, D.W., Transient eddy currents on finite plane and toroidal conducting surfaces, 4:40008 (PPPL—1517)
Weitkamp, C., Mobile lidar system for the measurement of gaseous pollutants in atmospheric air, 4:39542 (GKSS—78/E/42)
Wellesley-Miller, S., Weather responsive building skins: concepts and configurations, 4:38459 (CONF-780337—P3, pp 8p, Book 2, Paper 5)
Wells, L.E., *See* Sanyal, S.K., 4.38524
Wen, C.Y., *See* Dutta, S., 4:39808
Wendelken, J.F., ELS vibrational study of carbon monoxide adsorbed on the Cu(110) surface, 4:39149
Weneser, J., *See* Phillips, R.L., 4:39886
Weng, W.T., 1.5 GeV/c multiturn shaving extraction and its transport line for the Brookhaven AGS, 4:39429 (BNL—25784)
Beam transfer from the AGS to ISABELLE, 4:39469 (BNL—25783)
Werne, R.W., Structural response of VRO and FKM propellants during a rocket motor implosion, 4:39261 (UCID—18160)
Wesely, M.L., Dry deposition and emission of small particles at the surface of the earth, 4:39529 (CONF-790101—6)
Wesson, T.C., *See* Bond, D.C., 4:38139
Westlake, D.G., *See* Brun, T.O., 4:39174
Wewerka, E.M., Assessment and control of water contamination associated with shale oil extraction and processing. Work plan, 4:38202 (LA—7697)
Whalen, J., *See* Smith, A., 4:39909
Wharton, W.R., *See* Dytman, S.A., 4:39896
Whealton, J.H., *See* Stirling, W.L., 4:40011
Wheelock, T.D., Advanced development of fine coal desulfurization and recovery technology. Annual technical progress report, October 1, 1977—September 30, 1978, 4:38044 (IS—4668)
Whitaker, R.B., Energy storage for solar air conditioning applications utilizing a form-stable, high density polyethylene pellet bed, 4:38506 (MLM—2598(OP))
White, C.W., *See* Appleton, B.R., 4:39196
White, L.R., Status of air heater development in the United States for MHD systems, 4:38959 (CONF-781009—, pp 417-438)
White, P.R., *See* Scott, D.R., 4:38491
White, W.B., *See* Tsong, I.S.T., 4:39213

White, W.H., Formation and transport of light-scattering aerosols in the St. Louis urban plume, 4:39575
Whitehouse, H.T., South-wall heating system for a commercial building employing tilt-up concrete construction, 4:38456 (CONF-780337—P3, pp 8p, Book 2, Paper 1)
Whitlock, R.R., *See* Armstrong, C.M., 4:39985
Whitman, R.F., *See* Wilson, E.M., 4:39047
Whitten, J.L., Theoretical studies of chemisorption on transition metal surfaces: interaction of hydrogen with titanium, 4:39229 (LBL—8975, pp 60.-61.)
Whitten, R.C., *See* Hamill, P., 4:39577
Wickham, M.D., *See* Grisham, D.L., 4:39451
Widner, M.M., *See* Farnsworth, A.V. Jr., 4:40017
Wieland, J.S., Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB—283809)
Wiita, P.J., *See* Eichler, D., 4:39754
Wilcox, J.M., *See* Schatten, K.H., 4:39746
Wilczek, F., *See* Toussaint, D., 4:39737
Wilde, D., *See* McCormick, J.B., 4:38525
Wildman, G.C., Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978—December 31, 1979, 4:39236 (BETC—5603-6)
See McCormick, C.L., 4:39235
Wilgen, J.B., *See* Murakami, M., 4:39970
Wilhelm, H., Design and testing of power plant controls by means of simulation, 4:38568 (AED-Conf—78-155-024)
Wilhelm, J.G., *See* Deuber, H., 4:38762
Wilkenfeld, J.M., Radiation effects in satellite cables. Final report 1 Apr 77-31 Mar 78, 4:39502 (AD-A—059446)
Wilkins, B.D., Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium, 4:39924
See Kaufman, S.B., 4:39901
Wilkins, M.L., Mechanics of penetration and perforation, 4:39133
Wilkinson, M.K., Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL—5486)
Willard, H.B., *See* Anderson, B.D., 4:39906
Willer, D.C., Potential at existing impoundments, 4:38328
Some basic considerations, 4:38343
Williams, B.M., *See* Bliss, C., 4:38125
Williams, J.E.C., Superconducting magnetohydrodynamic magnet development program, Phase I. Quarterly technical progress report No. 6, October 1—December 31, 1977, 4:38970 (MIT—2295-1)
Williams, J.M., EASYTBL: phototypeset tables for LASL reports, 4:40036 (LA—7633-M)
Williams, M.C., Radiation exposure usage accountability and impact with respect to ALAP (ALARA) analysis, 4:38785 (UNI—1197)
Williams, P.F., Passive solar heated house and greenhouse on Cape Cod, description and performance, 4:38447 (CONF-780337—P2, pp 2p, Book 3, Paper 3)
Williams, R., *See* Adler, R., 4:39382
Williams, R.S., *See* Denley, D., 4:39158
Williams, S.W., *See* Potter, J.M., 4:39401
Williams, W.R., *See* Powell, J.L., 4:38048
Williams, W.S., Catalytic activity of transition-metal carbides, 4:38989 (LBL—8975, pp 70.-72.)
Williams, W.S.C., *See* Kirk, T.B.W., 4:39825
Williamson, J.V., Economics of small hydroelectric projects, 4:38342
Williford, R.E., *See* Lanning, D.D., 4:38750
Willke, T.L., *See* Denning, R.S., 4:38942
Willows, J.L., *See* Lytle, R.J., 4:39709
Wilson, B.L.H., Physics of semiconductors, 1978, 4:39950
Wilson, E.L., *See* Lee, M.C., 4:38826
Wilson, E.M., Engineering and economic analysis of waste to energy systems. Final report, April 1975—June 1977, 4:39047 (PB—285797)
Wilson, J.L., *See* Moody, G.W., 4:38560
Wilson, K., *See* Serne, J.C., 4:39561
Wilson, R., *See* Kirk, T.B.W., 4:39825
Wilson, R.R., Colliding beams at Fermilab, 4:39476 (LBL—7574, pp 7-12)
Proton cooling by radiation, 4:39418 (LBL—7574, pp 155-156)
Wilson, S.R., *See* Appleton, B.R., 4:39196
Wilson, W.E., *See* Hitchcock, D.R., 4:39563
Wilson, W.E. Jr., *See* White, W.H., 4:39575
Winch, T.R., *See* Johnson, E.K., 4:39711
Windawi, H., AES study of oxidation of surface and bulk sulfides of Ni, 4:39150
Wing, R.E., Removal of heavy metals from industrial wastewaters using insoluble starch xanthate. Final report, July 1975—June 1976, 4:39351 (PB—283792)
Winkelmann, I., Monitoring of airborne releases from LWR power plants in the Federal Republic of Germany, 4:38777
Winkler, G., *See* Smith, A., 4:39909
Wirtz, G.P., Physical and catalytic properties of oxides, 4:39230 (LBL—8975, pp 67.-69.)
Wiser, W.H., Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January—March 1978, 4:38055 (FE—2006-11)
Wisleder, R., *See* Bland, R., 4:38172
Witherow, J.L., Water reuse in poultry processing, 4:39044 (PB—283695)
Withers, H.W., *See* Epstein, R.A., 4:39216
Witherspoon, P.A., *See* Narasimhan, T.N., 4:39708
See Pruess, K., 4:38512
Witkover, R.L., *See* Weng, W.T., 4:39429
Witt, F., *See* Weil, R., 4:39512
Wittenberg, L.J., Evaluation of a large nonconvective solar pond, 4:38492 (MLM—2606(OP))
Woehrle, T.G., Large-area boron and carbon scatterers and filters, 4:39187 (UCID—18077)
Wojcik, T.A., Dowel pin, 4:39264
Wolf, A.P., *See* Ruiz, H.V., 4:39898
Wolf, C.H., *See* Stenhouse, D.S., 4:38428
Wolf, D., Fuel consumption measuring device, 4:39061
Wolf, D.C., *See* Mulchi, C.L., 4:38593, 4:38594, 4:38595, 4:38596, 4:38597
Wolf, K.L., *See* Dyer, P., 4:39925
Wolf, L., *See* Todreas, N.E., 4:38663, 4:38664
Wolf, S.A., *See* Edelsack, E.A., 4:39955
Wolfe, J.H., *See* Mihalov, J.D., 4:39748
Wolfe, K.J., *See* Salvesen, K.G., 4:39565
Wolff, W.F., Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals, 4:38070
Wong, J., *See* Solin, S.A., 4:39952
Wong, M.C., Transverse electrically excited iodine laser, 4:39325
Wong, P., *See* Lansing, F.L., 4:38996
Woo, K.C., *See* Wakabayashi, N., 4:39190
Wood, D.S., Materials data for severe variable loading, 4:38697
Wood, J.R., *See* Harris, G.S., 4:38913
Woodall, J.M., *See* Cuomo, J.J., 4:38503
Woodford, R., *See* Hull, L., 4:39559
Woodman, H.R., Tidal power plant and method of power generation, 4:38556
Woods, R., SNEAP: Symposium of North-Eastern Accelerator Personnel, 4:39359 (LA—7445-C)
Staffing for operational safety and efficiency, 4:39361 (LA—7445-C, pp 31-40)
Woodson, H.C., State of the art survey and measurements of releases within confinement structures from MOX fuel fabrication components, 4:38236 (WCAP—9282)
Woodsum, H.C., State-of-the-art survey of residual holdup in a 200 mt/yr MOX fuel fabrication facility, 4:38296 (WCAP—9128)
Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility, 4:38235 (WCAP—9278)
Waste management state-of-the-art review for mixed-oxide fuel fabrication facilities, 4:38234 (WCAP—9200)
Woodworth, J.R., Environmental and aesthetic aspects of low-head dams, 4:38348
Woosley, S.E., *See* Weaver, T.A., 4:39736
Workhoven, R.M., *See* Dudley, V.E., 4:38497, 4:38501
Wormhoudt, J.C., Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas, 4:38982 (CONF-781009—, pp 849-883)
Wouters, L.F., H.E. EMP: The "HASH", 4:39520 (UCID—18165)
Wray, P., The West Indian manatee (Trichechus manatus) in Florida: a summary and analysis of biological, ecological, and administrative problems affecting preservation and restoration of the population. Final report, 4:39609 (PB—285410)
Wright, D., Natural solar/microclimate/solid-state design, 4:38419 (CONF-780337—P1, pp 3p, Book 1, Paper 2)
Wright, E.A., *See* Spalaris, C.N., 4:38667
Wright, G.F. Jr., *See* Sheldahl, R.E., 4:39179
Wright, J., *See* Schlessinger, L., 4:39796
Wright, S.C., *See* Bowman, J.D., 4:39818
Wrobleski, J.T., *See* Brown, D.B., 4:39217
Wu, C., Direct energy conversion devices and their potential naval applications. Final report 1 jul-15 oct 76, 4:38943 (AD-A—059384)
Wu, C.K., *See* Skriba, M.C., 4:38233
Wu, J., *See* Ganic, E.N., 4:38411
Wu, S.M., *See* Chow, M.C., 4:38755
Wu, Y.C.L., Experimental investigation on a direct coal-fired MHD generator, 4:38956
Wulff, W., *See* Agrawal, A.K., 4:38812
Wyeth, R.K., Aquatic disposal field investigations, Ashtabula River disposal site, Ohio. Appendix C. Investigation of water-quality and sediment parameters. Final report December 1974—January 1977, 4:39537 (AD-A—057461)
Wyman, R.H., *See* Anderson, R.E., 4:39974

Y

Yablokov, B.N., *See* Kolomensky, A.A., 4:39387, 4:39396
Yackle, T.R., PBF-LOCA single rod tests program experiment specification document, 4:38825 (TFBP-TR—279)
Yaffe, L.G., *See* Levine, H., 4:39876

Yamada, M., *See* Nishi, M., 4:40020
Yamamoto, R., *See* Tanabe, J., 4:40019
Yamamoto, S., *See* Bokharee, S.A., 4:39444
Yamanouchi, T., *See* Vidal, R., 4:39828
Yamin, P., Tests of a new secondary emission chamber at the AGS, 4:39435 (BNL—25795)
Yanagisawa, K., Fuel pin behavior during UO_2 pellet melting, 4:38808 (JAERI-M—7503)
Yang, C.H., Many-particle theory of nuclear system with application to neutron-star matter and other systems. Semiannual status report, February. 1978—July 1978, 4:39930 (N—78-31019)
Yang, H.K., In-vessel core debris coolability for large breeder reactors, 4:38800 (GEFR—00415)
Yang, R.T., Carbonaceous fuel combustion with improved desulfurization, 4:38608
Yang, W.C., *See* Skriba, M.C., 4:38233
Yarberry, V.R., Automated system for electrical field-polarization studies in ferroelectrics, 4:39178
Yates-Williams, M.A., *See* Frank, J.S., 4:39832
Yeghiayan, R.P., Blast and thermal effects of multiple nuclear burst exposure of aircraft in a base-escape mode. Final report jan-oct 77, 4:39524 (AD-A—058301)
Yellin, S.J., *See* Caldwell, D.O., 4:39817
Yellott, J.I., Passive systems for solar heating and cooling: historical perspective, 4:38418 (CONF-780337—P1, pp 4p, Book 1, Paper 1)
Yemets, Yu.P., *See* Bystry, A.I., 4:38979
Yesil, O., Blackbody optical pumping of carbon dioxide laser mixtures, 4:39323
Yoh, J.K., *See* Vidal, R., 4:39828
Yokooku, K., *See* Kobayashi, K., 4:39083
Yoo, M.H., Elastic energy of slit cracks in hexagonal crystals, 4:39130
Yorozu, M., New energy technology-Strategy and evaluation, 4:38511
Yoshimura, H.R., Environmental impact of accidents involving radioactive material shipping systems, 4:39279 (SAND—78-1584C)
Yost, B., *See* Dris, M., 4:39826
Young, F.C., *See* Armstrong, C.M., 4:39985
Young, F.W. Jr., *See* Wilkinson, M.K., 4:38822
Young, K.B., The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB—283975)
Young, L.E., *See* Costogue, E.N., 4:38378, 4:38379
Young, P.G., Summary documentation of LASL nuclear data evaluations for ENDF/B-V, 4:39878 (LA—7663-MS)
See Baxman, C.I., 4:39879
See Hale, G.M., 4:39883, 4:39892, 4:39893
See Madland, D.G., 4:39922
See Mann, F., 4:39921
See Stewart, L., 4:39881
Yu, S.S., *See* Bangerter, R.O., 4:40016
Yu, W.S., Thermal hydraulics of accelerator breeder systems for regeneration of reactor fuel assemblies, 4:39438 (BNL—25880)
Yuan, S.W., Solar energy storage and utilization, 4:38508
Yuasa, Y., *See* Iimura, H., 4:38735
Yudelson, J., Potential for state government assistance to community solar energy enterprises, 4:38369
Yuen, D.L., Analysis of five-spot tracer tests to determine reservoir layering, 4:38133 (SAN—1265-8)
Yuhara, K., *See* Seikieka, M., 4:38549
Yundev, D.N., *See* Vasil'eva, I.A., 4:38981
Yuryshev, N.N., *See* Bashkin, A.S., 4:39317, 4:39318
Yusef, N.A., *See* Tsong, I.S.T., 4:39213
Yushko, K.B., *See* Grasyuk, A.Z., 4:39310
Yust, C.S., *See* Harris, L.A., 4:38082
Yusupov, I.G., Precipitation of hydrolyzed polyacrylonitride in a porous media as applied to the isolation of injected water, 4:38146

Z

Zaichenko, V.M., *See* Volovik, A.V., 4:38961
Zajac, G., Relationship of optical degradation to surface morphology changes in solar absorbers, 4:38502
Zajec, E., *See* Barale, J.J., 4:39457
Zalkind, V.I., *See* Burenkov, D.K., 4:38974
Zamyslov, O.B., *See* Burenkov, D.K., 4:38974
Zang, H.K., *See* Reid, R.E., 4:39246
Zanner, F.J., Observations of the vacuum arc and metal transfer during vacuum consumable arc remelting, 4:39095 (SAND—79-0922C)
Zanotelli, W.A., 1978 annual report: aerosol characterization from a simulated HCDA, 4:38820 (NUREG/CR—0740)
Zaric, Z.P., Thermal effluent disposal from power generation, 4:39622
Zasavitskii, I.I., *See* Gureev, D.M., 4:39309
Zavitsanos, P.D., Coal desulfurization using microwave energy. Final report, August 1976—October 1977, 4:38045 (PB—285880)
See Golden, J.A., 4:39283
Zawoyski, F.C., Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP—9104(Add.3))
Zee, A., *See* Toussaint, D., 4:39737
Zehner, D.M., High-resolution LMM Auger spectra from argon implanted in Be and Si, 4:39153
Zelenski, A., *See* Kalinowski, T., 4:38616
Zellars, G.R., Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N—78-28225)
Zemann, H., Principles of measurement and of safety surveillance for the PCPV/helium-loop, 4:38743 (SGAE—2820)
Zenker, P., *See* Deuster, G., 4:38714
Zerzan, J.M., *See* Pruess, K., 4:38512
Zhelnin, V.A., *See* Buznikov, A.E., 4:38976
Ziegler, D.L., Recovery of plutonium from insulation, scrap glass, and sand-slag residues, 4:38257 (RFP—2835)
Ziegler, J.F., *See* Cuomo, J.J., 4:38503
Ziegler, L.H., Intercomparison of plutonium-239 measurements. Final report, 4:39201 (PB—285438)
Ziegler, N.F., Control system for the Holifield Heavy Ion Research Facility beam buncher, 4:39443 (CONF-790327—9)
See Juras, R.C., 4:39426
See Milner, R., 4:39425
Zimmerman, N., *See* Goldgraben, G.R., 4:39564
Zimmermann, C., Thermal loading of river systems, 4:39630
Zinneman, T.E., *See* Smith, R.P., 4:38958
Zoellner, W.D., Noise considerations in millimeter-wave spectrometers, 4:39494 (LBL—7294)
Zoller, P., Physical fundamentals of reactor engineering, 4:38720 (AED-Conf—78-023-002)
Zuppan, A.W., Morey mill retrofit, 4:39262 (UCID—18170)
Zurro, B., *See* Murakami, M., 4:39970
Zverkov, M.V., *See* Borodulin, V.I., 4:39316
Zvorykin, V.D., *See* Basov, N.G., 4:39311
Zwart, G.W., Hybrid solar system in Los Alamos, New Mexico, 4:38439 (CONF-780337—P2, pp 5p, Book 2, Paper 9)
Zweidinger, R.A., *See* Pellizzari, E.D., 4:39202

SUBJECT INDEX

The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR/QUALIFIER
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

A

ABLATION/MEASURING METHODS
Multi-ray ablation sensor development program. Final report, 2 June 1975-15 December 1976, 4:39496 (AD-A-058366)

A-BOMB SURVIVORS/BIOLOGICAL RADIATION EFFECTS
Atomic Bomb Casualty Commission. Annual report, 1 July 1973-30 June 1974, 4:39660 (ABCC-TR-73-74)

A-BOMB SURVIVORS/GENETICS
Atomic Bomb Casualty Commission. Annual report, 1 July 1973-30 June 1974, 4:39660 (ABCC-TR-73-74)

A-BOMB SURVIVORS/NEOPLASMS
Atomic Bomb Casualty Commission. Annual report, 1 July 1973-30 June 1974, 4:39660 (ABCC-TR-73-74)

ACCELERATOR BREEDERS/COOLING SYSTEMS
Thermal hydraulics of accelerator breeder systems for regeneration of reactor fuel assemblies, 4:39438 (BNL-25880)

ACCELERATOR BREEDERS/FEASIBILITY STUDIES
Concept evaluation of a nuclear design for electronuclear fuel production: evaluation of ORNL's proposed TMF-ENFP, 4:39460 (ORNL/TM-6828)

ACCELERATOR BREEDERS/PERFORMANCE
Nuclear performance of target-blanket assemblies for electronuclear fuel production, 4:39360 (CONF-780622-30)

ACCELERATOR FACILITIES/SAFETY
Staffing for operational safety and efficiency, 4:39361 (LA-7445-C)

ACCELERATORS
See also BEVATRON
BROOKHAVEN AGS
COLLECTIVE ACCELERATORS
CYCLIC ACCELERATORS
ELECTRON-RING ACCELERATORS
ELECTROSTATIC ACCELERATORS
HEAVY ION ACCELERATORS
LAMPF LINAC
LINEAR ACCELERATORS
ORNL ISOCHRONOUS CYCLOTRON
STORAGE RINGS
VAN DE GRAAFF ACCELERATORS
ZGS

ACCELERATORS/BEAM DYNAMICS
Are we beating Liouville's theorem, 4:39415 (LBL-7574)

ACCELERATORS/BEAM TRANSPORT
Role of space charge in beam transport, 4:39398

ACCELERATORS/OPERATION
Summaries of FY 1978 research in nuclear physics, 4:39877 (DOE/ER-0020)

ACCELERATORS/SAFETY
Staffing for operational safety and efficiency, 4:39361 (LA-7445-C)

ACCOUNTING
Application of advanced accountability concepts in mixed oxide fabrication, 4:38228 (WCAP-9104)
Impact of receipt of coprocessed uranium/plutonium on advanced accountability concepts and fabrication facilities. Addendum 1 to application of advanced accountability concepts in mixed oxide fabrication, 4:38229 (WCAP-9104(Add.1))
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP-9104(Add.3))

ACES
See QUARKS

ACETIC ACID/REMOVAL
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM-6672)

ACETONE/PHOTOIONIZATION
Photoionization mass spectrometric studies of selected compounds in a molecular beam, 4:39793 (LA-7727-T)

ACID RAIN/BIOLOGICAL EFFECTS
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)

ACID RAIN/MEASURING METHODS
Tipping-vessel recording raingauge, 4:39548 (N-78-28761)

ACRIDINE ORANGE/CRYSTAL STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR-3490-1574)

ACRIDINE ORANGE/MOLECULAR STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR-3490-1574)

ACRIDINES
See also ACRIDINE ORANGE

ACRIDINES/CRYSTAL STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3'-5')guanosine, 4:39244 (UR-3490-1573)

ACRIDINES/MOLECULAR STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3'-5')guanosine, 4:39244 (UR-3490-1573)
ACRYLIC POLYMERS
See POLYACRYLATES
ACTINIDE NUCLEI/ABUNDANCE
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
ACTINIDE NUCLEI/FISSION
Experimental survey of the potential energy surfaces associated with fission (Mass and axial symmetry, probability), 4:39938 (LA-UR-79-533)
ACTINIDE NUCLEI/FISSION BARRIER
Experimental survey of the potential energy surfaces associated with fission (Mass and axial symmetry, probability), 4:39938 (LA-UR-79-533)
ACTINIDE NUCLEI/NATURAL OCCURRENCE
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
ACTINIDE NUCLEI/SPONTANEOUS FISSION
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
ACTINIDES/AVAILABILITY
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
ACTINIDES/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
ACTINIDES/HEALTH HAZARDS
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
ACTINIDES/INVENTORIES
User's guide to the reactor inventory code RICE, 4:38725 (RD-B-N-4079)
ACTINIDES/PHOTOCHEMISTRY
Photochemistry of the actinides, 4:39253 (CONF-790415-21)
ACTINOMYCIN/ABSORPTION SPECTROSCOPY
Absorption spectrum of actinomycin D. Evidence for three transitions in the visible band, 4:39636
ACTINOMYCIN/DIMERIZATION
Absorption spectrum of actinomycin D. Evidence for three transitions in the visible band, 4:39636
ACTIVATED CARBON/REGENERATION
Thermal regeneration of activated carbon, 4:38166 (PB-284065)
ACTIVATED CARBON/USES
Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater (Granular vs. powdered), 4:38161 (ANL/WR-79-3)
ACTIVATION DETECTORS/SENSITIVITY
Progress report on detector cross section benchmark measurements in the TAPIRO reactor, 4:39488 (IAEA-208(Vol.2))
ACTUATORS/DESIGN
Development of a unique pyrotechnic actuator, 4:39518 (SAND-78-1731C)
ACTUATORS/PERFORMANCE
Pyrotechnic output of TiH/sub x//$CKlO_4$ actuators. IV. Modelling of TiH/sub x//$KClO_4$ actuator pyrotechnic output, 4:39519 (SAND-79-0027)
ADENOCARCINOMAS
See CARCINOMAS
ADENOSINE TRIPHOSPHATE
See ATP
ADGEZATOR
See ELECTRON-RING ACCELERATORS
ADSORPTION/AUGER ELECTRON SPECTROSCOPY
AES study of the adsorption of O_2, CO, CO_2, and H_2O on indium, 4:39152
ADVERSARIES/DETECTION
Commercially available video motion detectors, 4:38295 (SAND-79-0186)
AEROSOL MONITORING
Vent-air monitoring in nuclear power plants by a nuclide-specific detection system, 4:38742
AEROSOL MONITORING/MICROPROCESSORS
Microprocessor-controlled inhalation system for repeated exposure of animals to aerosols, 4:39599
AEROSOLS
1978 annual report: aerosol characterization from a simulated HCDA, 4:38820 (NUREG/CR-0740)
AEROSOLS/AEROSOL MONITORING
Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL-7999)
AEROSOLS/DEPOSITION
Chalk point cooling tower project: cooling tower effects on crops and soils. preoperational report. Report for April 1973-April 1975, 4:38593 (PB-284075)
Chalk point cooling tower project: cooling tower effects on crops and soils. Preoperational report, appendix. Report for April 1973-April 1975, 4:38594 (PB-284076)
Dry deposition and emission of small particles at the surface of the earth, 4:39529 (CONF-790101-6)
AEROSOLS/ENVIRONMENTAL TRANSPORT
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
AEROSOLS/PARTICLE RESUSPENSION
Dry deposition and emission of small particles at the surface of the earth, 4:39529 (CONF-790101-6)
AEROSOLS/PHYSICAL PROPERTIES
Formation and transport of light-scattering aerosols in the St. Louis urban plume, 4:39575
AEROSOLS/REMOTE SENSING
Mobile lidar system for the measurement of gaseous pollutants in atmospheric air (For monitoring of aerosols such as No_2, SO_2, and HCl), 4:39542 (GKSS-78/E/42)
AEROSOLS/SIMULATION
One-dimensional model of the stratospheric aerosol, 4:39577
AEROSOLS/X-RAY FLUORESCENCE ANALYSIS
Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL-7999)
AEROSOLS/X-RAY SPECTROSCOPY
Application of x-ray emission spectra to the identification of particulate sulfur compounds in ambient air, 4:39544 (LBL-7284)
AGED
See ELDERLY PEOPLE
AGRICULTURAL WASTES
See also MANURES
AGRICULTURAL WASTES/ENERGY RECOVERY
Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
AGRICULTURAL WASTES/WASTE PROCESSING
Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
AGRICULTURE
See also FARMS
AGRICULTURE/BIBLIOGRAPHIES
Solar energy in agriculture, 1970-1977: 236 citations. Quick bibliography series, 4:38487 (NAL-BIBL-78-04)
AGRICULTURE/ENERGY ACCOUNTING
Energy policies: Price impacts on the U.S. food system. Final agricultural economic report, 4:38868 (PB-285869)
AGRICULTURE/IRRIGATION
Energy price levels and the economics of irrigation, 4:39031
AGRICULTURE/PRODUCTION
The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB-283975)
AGRICULTURE/WASTE HEAT UTILIZATION
Overview of waste heat utilization techniques, 4:39039 (CONF-790443-2)
AGRICULTURE/WATER REQUIREMENTS
Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976-30 September 1977, 4:38888 (PB-286038)
The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB-283975)
AIR
See also EARTH ATMOSPHERE
SURFACE AIR
AIR/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
AIR CLEANING SYSTEMS/AIR FILTERS
Iodine filter testing, 4:38744
AIR CONDITIONERS
See also SOLAR AIR CONDITIONERS
AIR CONDITIONERS/HEAT RECOVERY EQUIPMENT
Waste energy recovery system (Patent), 4:38999
AIR HEATERS
See also SOLAR AIR HEATERS
AIR HEATERS/MATERIALS
Materials, 4:39165
AIR HEATERS/TECHNOLOGY ASSESSMENT
High temperature air preheaters for a commercial scale MHD power plant, 4:38961 (CONF-781009-)

Status of air heater development in the United States for MHD systems, 4:38959 (CONF-781009-)

AIR INFILTRATION/MEASURING METHODS
Air leakage measurements in three apartment houses in the Chicago area, 4:39005 (PB-283722)

AIR POLLUTION
See also STATIONARY POLLUTANT SOURCES
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
Ecosystem Studies Program, 4:39615 (ORNL-5508)

AIR POLLUTION/AERIAL MONITORING
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)

AIR POLLUTION/AEROSOL MONITORING
Role of ammonia in the chemistry of atmospheric aerosols, 4:39543 (IVL-B-449)

AIR POLLUTION/AIR POLLUTION MONITORS
MAP3S programs applicable to PEPE's (PEPE = Persistent Elevated Pollution Episode; MAP3S = Multi-State Atmospheric Power Production Pollution Study), 4:39573 (UCRL-82549)

AIR POLLUTION/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)

AIR POLLUTION/CHEMICAL ANALYSIS
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)

AIR POLLUTION/CHEMICAL REACTIONS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)

AIR POLLUTION/ECONOMIC IMPACT
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

AIR POLLUTION/ENVIRONMENTAL EFFECTS
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977-15 April 1978, 4:39547 (N-78-27687)

AIR POLLUTION/ENVIRONMENTAL TRANSPORT
Analysis of meteorological conditions during the 1977 Anclote Keys Plume Study. Final report, February-November 1977, 4:39559 (PB-284905)
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
MAP3S programs applicable to PEPE's (PEPE = Persistent Elevated Pollution Episode; MAP3S = Multi-State Atmospheric Power Production Pollution Study), 4:39573 (UCRL-82549)

AIR POLLUTION/MATHEMATICAL MODELS
Georgetown, South Carolina air quality maintenance planning and analysis. Final report, 4:39570 (PB-286322)
The development of a regional air pollution model and its application to the Northern Great Plains. Final report, 4:39568 (PB-285980)

AIR POLLUTION/MERCURY
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)

AIR POLLUTION/MONITORING
Ambient monitoring guidelines for prevention of significant deterioration (PSD), 4:39552 (PB-283696)
An experimental/analytical program to assess the utility of lidar for pollution monitoring. Final report, 1 September 1976-31 October 1977, 4:39546 (N-78-27614)
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
Chalk Point Cooling Tower Project. Volume I, phase V. Analysis and archiving program, FY77. Final report, 1 July 1976-31 August 1977, 4:39556 (PB-284826)
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
Mobile lidar system for the measurement of gaseous pollutants in atmospheric air (For monitoring of aerosols such as No_2, SO_2, and HCl), 4:39542 (GKSS-78/E/42)
Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976-July 1977, 4:38199 (PB-284027)

AIR POLLUTION/NITROGEN OXIDES
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)

AIR POLLUTION/POLLUTION REGULATIONS
Ambient monitoring guidelines for prevention of significant deterioration (PSD), 4:39552 (PB-283696)

AIR POLLUTION/REGIONAL ANALYSIS
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)

AIR POLLUTION/SAMPLING
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)

AIR POLLUTION/SOCIAL IMPACT
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

AIR POLLUTION ABATEMENT/TECHNOLOGY ASSESSMENT
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)

AIR POLLUTION CONTROL/COST BENEFIT ANALYSIS
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

AIR POLLUTION MONITORS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)

AIR POLLUTION MONITORS/LASER RADIATION
An experimental/analytical program to assess the utility of lidar for pollution monitoring. Final report, 1 September 1976-31 October 1977, 4:39546 (N-78-27614)

AIR POLLUTION MONITORS/OPTICAL RADAR
Mobile lidar system for the measurement of gaseous pollutants in atmospheric air (For monitoring of aerosols such as No_2, SO_2, and HCl), 4:39542 (GKSS-78/E/42)

AIR POLLUTION MONITORS/RADIOMETERS
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)

AIR POLLUTION MONITORS/SPECTROMETERS
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)

AIR QUALITY/DATA ACQUISITION
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)

AIR QUALITY/DATA ANALYSIS
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)

AIR QUALITY/FORECASTING
Georgetown, South Carolina air quality maintenance planning and analysis. Final report, 4:39570 (PB-286322)

AIR QUALITY/MONITORING
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
Indoor air quality in energy-efficient buildings, 4:38995 (LBL-8892)

AIR QUALITY/REGIONAL ANALYSIS
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section

analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
AIR QUALITY/STANDARDS
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)
AIR TRANSPORT/MEETINGS
1977 international air transportation conference, 4:39019
AIRCRAFT/BLAST EFFECTS
Blast and thermal effects of multiple nuclear burst exposure of aircraft in a base-escape mode. Final report jan-oct 77, 4:39524 (AD-A-058301)
AIRCRAFT/EXHAUST GASES
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
AIRCRAFT/FUEL CONSUMPTION
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing, 4:39016 (N-78-31043)
AIRCRAFT/FUEL SYSTEMS
Study of fuel systems for LH2-fueled subsonic transport aircraft. Volume 1. Final report, September 1976-December 1977, 4:39017 (N-78-31085)
Study of fuel systems for LH2-fueled subsonic transport aircraftVolume 2. Final report, September 1976-December 1977, 4:39018 (N-78-31086)
AIRCRAFT/NICKEL-ZINC BATTERIES
Nickel-zinc battery for aircraft and missile applications. Final report 14 Feb 75-14 Feb 78, 4:38845 (AD-A-059295)
AIRCRAFT/TECHNOLOGY ASSESSMENT
CTOL transport technology, 1978, 4:39074 (N-78-27046)
AIRFOILS/AERODYNAMICS
Control-surface hinge-moment calculations for a high-aspect-ratio supercritical wing, 4:39016 (N-78-31043)
ALABAMA/COAL PREPARATION PLANTS
Recovering fine-size coal from Alabama underground mine washer wastes using the Humphreys spiral, 4:38119 (FE-9005-T1)
ALABAMA/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ALABAMA/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ALABAMA/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ALARM DOSEMETERS
See RADIATION MONITORS
ALARM SYSTEMS/DATA PROCESSING
Microcomputer-based video motion detection system, 4:38299 (Y/DA-7999)
ALASKA/ENERGY SOURCE DEVELOPMENT
Alaska OCS socioeconomic studies program. Technical report number 17. Monitoring petroleum activities in the Gulf of Alaska and lower Cook Inlet between April 1975 and June 1978. Final report, 4:38168 (PB-285408)
Alaska OCS socioeconomic studies program. Technical report number 18. Beaufort Sea petroleum development scenarios: economic and demographic impacts. Technical report, 4:38169 (PB-285409)
ALASKA/MAGNETIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Juneau Quadrangle, 4:38211 (GJBX-48(79)(Vol.2)(Juneau))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Ketchikan Quadrangle, 4:38212 (GJBX-48(79)(Vol.2)(Ketchikan))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Atlin Quadrangle, 4:38208 (GJBX-48(79)(Vol.2)(Atlin))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Bradfield Canal Quadrangle, 4:38209 (GJBX-48(79)(Vol.2)(Bradfield))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Craig Quadrangle, 4:38210 (GJBX-48(79)(Vol.2)(Craig))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Petersburg Quadrangle, 4:38213 (GJBX-48(79)(Vol.2)(Petersburg))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sitka Quadrangle, 4:38214 (GJBX-48(79)(Vol.2)(Sitka))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sumdum Quadrangle, 4:38216 (GJBX-48(79)(Vol.2)(Sumdum))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Skagway Quadrangle, 4:38215 (GJBX-48(79)(Vol.2)(Skagway))
ALASKA/RADIOMETRIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Juneau Quadrangle, 4:38211 (GJBX-48(79)(Vol.2)(Juneau))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Ketchikan Quadrangle, 4:38212 (GJBX-48(79)(Vol.2)(Ketchikan))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Atlin Quadrangle, 4:38208 (GJBX-48(79)(Vol.2)(Atlin))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Bradfield Canal Quadrangle, 4:38209 (GJBX-48(79)(Vol.2)(Bradfield))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Craig Quadrangle, 4:38210 (GJBX-48(79)(Vol.2)(Craig))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Petersburg Quadrangle, 4:38213 (GJBX-48(79)(Vol.2)(Petersburg))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sitka Quadrangle, 4:38214 (GJBX-48(79)(Vol.2)(Sitka))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sumdum Quadrangle, 4:38216 (GJBX-48(79)(Vol.2)(Sumdum))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Skagway Quadrangle, 4:38215 (GJBX-48(79)(Vol.2)(Skagway))
ALGAE
See also PHYTOPLANKTON
ALGAE/PRODUCTION
Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report, 4:39041 (PB-285709)
ALGORITHMS/COMPARATIVE EVALUATIONS
Computer methods for sampling from the gamma distribution, 4:40039 (LA-UR-78-2116)
ALGORITHMS/EVALUATION
Simulation test approach to the evaluation of nonlinear optimization algorithms, 4:40046
ALKANES
See also CYCLOALKANES
2-2-DIMETHYLPROPANE
HEPTANE
HEXANE
METHANE
2-METHYLPROPANE
PENTANE
PROPANE
ALKANES/PHOTOIONIZATION
Laser photodetachment of electrons from O_2p in nonpolar liquids), 4:39250
ALKENES
See also BUTENES
ETHYLENE
PROPYLENE
ALKENES/ELECTRON COLLISIONS
Electron impact spectra of some mono-olefinic hydrocarbonsa), 4:39775
ALKENES/FISCHER-TROPSCH SYNTHESIS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
ALLOY 800
See INCOLOY 800
ALLOY-IN-100/ALUMINIUM OXIDES
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
ALLOY-IN-100/FATIGUE
Low cycle fatigue behavior of IN-100: strainrange partitioning method, 4:39137
ALLOY-IN-100/MECHANICAL PROPERTIES
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
ALLOYS
High temperature materials requirements of the magnetohydrodynamic energy conversion, 4:38972
ALLOYS/CREEP
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134

ALLOYS/FATIGUE
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134
ALLOYS/MEETINGS
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134
ALLOY-TZM
High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat, 4:39143
ALLYL RADICALS/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
ALLYL RADICALS/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
ALPHA PARTICLES/BIOLOGICAL EFFECTS
Transformations of C3H 10T1/2 cells by Benzo(a)pyrene and subsequent attempts at suppression of transformed foci by untransformed cells and Vitamin A (Alpha particles), 4:39686 (ANL-78-65(Pt.2))
ALPHA PARTICLES/BIOLOGICAL RADIATION EFFECTS
Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship (^{226}Ra, ^{239}Pu), 4:39675 (ANL-78-65(Pt.2))
Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL-78-65(Pt.2))
Suppression of transformed foci, induced by alpha radiation of C3H 10T1/2 cells, by untransformed cells, 4:39685 (ANL-78-65(Pt.2))
ALUMINIUM/DEFORMATION
Mechanics of penetration and perforation, 4:39133
ALUMINIUM/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
ALUMINIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
Spectral method for determining impurities in anthracite and oil coke, 4:38084
ALUMINIUM/ION CHANNELING
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
ALUMINIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
ALUMINIUM/PHOTOELECTRON SPECTROSCOPY
Photoemission study of Al/III-V interfaces, 4:39953
ALUMINIUM/PHYSICAL RADIATION EFFECTS
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL-25733)
ALUMINIUM/PRODUCTION
Energy use in the production of primary aluminum, 4:38939
ALUMINIUM/PROTON REACTIONS
Spallation of aluminum by 300 GeV protons, 4:39901
ALUMINIUM/THERMODYNAMIC PROPERTIES
Quantum-statistical model for high-density matter, 4:39155
ALUMINIUM 27 TARGET/L CODES
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
ALUMINIUM 27 TARGET/SIMULATION
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
ALUMINIUM ALLOYS
See also ALUMINIUM BASE ALLOYS
ALUMINIUM ALLOYS/ANNEALING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
ALUMINIUM ALLOYS/CHEMICAL BONDS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
ALUMINIUM ALLOYS/CREEP
Strainrange partitioning applied to Ti-6Al-V, 4:39140
ALUMINIUM ALLOYS/CRYSTAL-PHASE TRANSFORMATIONS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
ALUMINIUM ALLOYS/DEGASSING
Performance of vacuum components operating at 1×10^{-11} Torr, 4:39486
ALUMINIUM ALLOYS/ELECTROCHEMICAL CORROSION
Experimental application of design principles in corrosion research, 4:39183
ALUMINIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ALUMINIUM ALLOYS/EMBRITTLEMENT
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
ALUMINIUM ALLOYS/ENERGY-LEVEL DENSITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
ALUMINIUM ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
Strainrange partitioning applied to Ti-6Al-V, 4:39140
ALUMINIUM ALLOYS/FERMI LEVEL
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
ALUMINIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ALUMINIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ALUMINIUM ALLOYS/POSITRON CHANNELING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
ALUMINIUM ALLOYS/PRECIPITATION
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
ALUMINIUM ALLOYS/SUPERCONDUCTIVITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
ALUMINIUM BASE ALLOYS/ACOUSTIC EMISSION TESTING
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL-81879)
ALUMINIUM BASE ALLOYS/DEPOSITION
Deposition of aluminum-copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX-613-2173)
ALUMINIUM BASE ALLOYS/FRACTURE PROPERTIES
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL-81879)
ALUMINIUM BASE ALLOYS/MICROSTRUCTURE
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL-81879)
ALUMINIUM OXIDES/CATALYTIC EFFECTS
Properties of supported metal catalysts, 4:39226 (LBL-8975)
ALUMINIUM OXIDES/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
ALUMINIUM OXIDES/MECHANICAL PROPERTIES
Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80, 4:39135
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
ALUMINIUM OXIDES/MICROSTRUCTURE
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
ALUMINIUM OXIDES/REDUCTION
Chemical reduction of refractory oxides by atomic hydrogen, 4:39254 (LBL-8548)
ALUMINIUM OXIDES/SEED-SLAG INTERACTIONS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
ALUMINIUM OXIDES/SURFACE COATING
Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80, 4:39135
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
AMBIENT TEMPERATURE/DATA ACQUISITION
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
AMBIENT TEMPERATURE/DATA ANALYSIS
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
AMEBA
See AMOEBA

AMERICIUM/PURIFICATION
Americium recovery and purification at Rocky Flats, 4:38241 (RFP-2886)
AMERICIUM/RECOVERY
Americium recovery and purification at Rocky Flats, 4:38241 (RFP-2886)
AMERICIUM 241/COUNTING TECHNIQUES
Method for the determination of ^{241}Am in urine (^{243}Am), 4:39199 (ANL-78-65(Pt.2))
AMERICIUM 241/INGESTION
Ingestion of ^{241}Am sources intended for domestic smoke detectors: report of a case, 4:39683 (ANL-78-65(Pt.2))
AMERICIUM 241/INHALATION
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
AMERICIUM 241/TISSUE DISTRIBUTION
Radiological and Environmental Research Division annual report, July 1977-June 1978, 4:39670 (ANL-78-65(Pt.2))
AMERICIUM 241 TARGET/NEUTRON REACTIONS
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
AMERICIUM 242 TARGET/NEUTRON REACTIONS
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
AMERICIUM 243 TARGET/NEUTRON REACTIONS
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
AMERICIUM ISOTOPES/AVAILABILITY
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
AMERICIUM ISOTOPES/HEALTH HAZARDS
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
AMES TEST
See MUTAGEN SCREENING
AMINES
See also ACRIDINE ORANGE
RHODAMINES
AMINES/CHEMICAL REACTION YIELD
Catalytic hydrogenation process, 4:39246
AMINOGLYCIDES
See AMINES
AMMONIA/AEROSOL MONITORING
Role of ammonia in the chemistry of atmospheric aerosols, 4:39543 (IVL-B-449)
AMMONIA/BIOSYNTHESIS
Assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation, 4:38324 (N-78-30798)
AMMONIA/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
AMMONIA/CHEMICAL REACTIONS
Catalytic hydrogenation process, 4:39246
AMMONIUM COMPOUNDS/AEROSOL MONITORING
Determination of ambient H_2SO_4 and it's ammonium salts by in situ aerosol thermal analysis, 4:39574
AMMONIUM COMPOUNDS/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
AMMONIUM COMPOUNDS/ION EXCHANGE
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
AMNION CELLS
See EMBRYONIC CELLS
AMOEBA/DNA
Quantitation by flow microfluorometry of total cellular DNA in Acanthamoeba, 4:39647
AMOEBA/PATHOGENESIS
Cooling Systems Program, 4:39621 (ORNL-5508)
ANGIOGRAPHY
See BIOMEDICAL RADIOGRAPHY
ANIMAL CELLS
See also EMBRYONIC CELLS
ANIMAL CELLS/BIOLOGICAL RADIATION EFFECTS
Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL-78-65(Pt.2))
ANIMAL CELLS/DIMENSIONS
Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship (^{226}Ra, ^{239}Pu), 4:39675 (ANL-78-65(Pt.2))
ANIMAL CELLS/DOSE RATES
Analysis of thick source alpha particle spectrum from radium and its daughters in bone (^{226}Ra, ^{214}Po), 4:39678 (ANL-78-65(Pt.2))
ANIMAL CELLS/RADIONUCLIDE KINETICS
Radiological and Environmental Research Division annual report, July 1977-June 1978, 4:39670 (ANL-78-65(Pt.2))
ANIMAL FEEDS/BIOSYNTHESIS
Management of swine manure for the recovery of protein and biogas. Final report, 4:38318 (PB-286722)
ANTHRACITE/CHEMICAL ANALYSIS
Spectral method for determining impurities in anthracite and oil coke, 4:38084
ANTIMUONS
See MUONS PLUS
ANTINEUTRINO-NUCLEON INTERACTIONS/CHARGED-CURRENT INTERACTIONS
Recent results on neutrino reactions (Review), 4:39820 (COO-3071-237)
ANTINEUTRINO-NUCLEON INTERACTIONS/INCLUSIVE INTERACTIONS
Recent results on neutrino reactions (Review), 4:39820 (COO-3071-237)
ANTIPROTON BEAMS/BEAM BUNCHING
Antiproton momentum compactor-debuncher linac, 4:39420 (LBL-7574)
ANTIPROTON BEAMS/BEAM PRODUCTION
Anti p production characteristics and collection systems, 4:39414 (LBL-7574)
ANTIPROTON BEAMS/BEAM TRANSPORT
Anti p production characteristics and collection systems, 4:39414 (LBL-7574)
ANTIPROTON BEAMS/ELECTRON COOLING
Beam stability considerations during electron cooling, 4:39419 (LBL-7574)
Collecting anti protons in the Fermilab Booster and very high energy proton-anti proton interactions. Appendix C, 4:39422 (LBL-7574)
Electron beam cooling: prospects of ribbon-type E-beams, 4:39478 (LBL-7574)
Relativistic electron cooling for high luminosity proton-anti proton colliding beams at very high energies, 4:39413 (LBL-7574)
ANTIPROTON BEAMS/FOCUSING
Anti p production characteristics and collection systems, 4:39414 (LBL-7574)
ANTIPROTON BEAMS/STOCHASTIC PROCESSES
Accommodating stochastic cooling at Fermilab, 4:39416 (LBL-7574)
Proposed p-anti p colliding beam facility at CERN, 4:39411 (LBL-7574)
ANTIREFLECTION COATINGS/FAILURES
Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N-78-30656)
ANTS
See INSECTS
APARTMENT BUILDINGS/AIR INFILTRATION
Air leakage measurements in three apartment houses in the Chicago area, 4:39005 (PB-283722)
APOLIPOPROTEINS/BIOCHEMICAL REACTION KINETICS
Asymmetry of apolipoprotein A-I in solution as assessed from ultracentrifugal, viscometric, and fluorescence polarization studies, 4:39643
APPALACHIA/ENERGY SOURCE DEVELOPMENT
Energy R and D implications for Appalachia: An evaluation methodology. Volume I. Technical report. Final report, 4:38878 (PB-284014)
APPLIANCES
See also AIR CONDITIONERS
CLOTHES DRYERS
STOVES
APPLIANCES/ENERGY EFFICIENCY
National energy plan: energy conservation in appliances. Final report, 4:39004 (HIT-691)
AQUACULTURE/SOLAR PROCESS HEAT
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
AQUACULTURE/TOTAL ENERGY SYSTEMS
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
AQUACULTURE/WASTE HEAT UTILIZATION
Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report, 4:39041 (PB-285709)
Overview of waste heat utilization techniques, 4:39039 (CONF-790443-2)
AQUATIC ECOSYSTEMS/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)

AQUATIC ECOSYSTEMS/MONITORING
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
AQUATIC ECOSYSTEMS/POLLUTION
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
Synthetic Fuels Program, 4:38090 (ORNL-5508)
AQUATIC ORGANISMS
(Unspecified biota characteristic of aquatic ecosystems.)
See also FISHES
MOLLUSCS
PLANKTON
AQUATIC ORGANISMS/SURVIVAL TIME
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
ARCHAEOLOGICAL SPECIMENS/ACTIVATION ANALYSIS
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 1. 1964-1976 (a bibliography with abstracts). Report for 1964-1976, 4:39206 (NTIS/PS-78/1241)
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 2. 1977-november, 1978 (a bibliography with abstracts). Report for 1977-Nov 78, 4:39207 (NTIS/PS-78/1242)
ARCHAEOLOGICAL SPECIMENS/BIBLIOGRAPHIES
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 1. 1964-1976 (a bibliography with abstracts). Report for 1964-1976, 4:39206 (NTIS/PS-78/1241)
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 2. 1977-november, 1978 (a bibliography with abstracts). Report for 1977-Nov 78, 4:39207 (NTIS/PS-78/1242)
ARCHAEOLOGICAL SPECIMENS/PRESERVATION
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 1. 1964-1976 (a bibliography with abstracts). Report for 1964-1976, 4:39206 (NTIS/PS-78/1241)
Archaeology: site studies, activation analysis, preservation, and remote sensing. volume 2. 1977-november, 1978 (a bibliography with abstracts). Report for 1977-Nov 78, 4:39207 (NTIS/PS-78/1242)
ARCHITECTURE/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
ARGON/AUGER ELECTRON SPECTROSCOPY
High-resolution LMM Auger spectra from argon implanted in Be and Si, 4:39153
ARGON/BAND THEORY
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)
ARGON/CHARGED-PARTICLE TRANSPORT
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
ARGON/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
ARGON/ELECTRON-ATOM COLLISIONS
Theoretical cross sections for ionization of metastable excimers Ne^*_2 and Ar^*_2 by electron impact, 4:39797
ARGON/ELECTRONIC STRUCTURE
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)
ARGON/PHOTOIONIZATION
Laser photodetachment of electrons from O_2^- in nonpolar liquids), 4:39250
ARGON/PUMPING
Performance of vacuum components operating at 1×10^{-11} Torr, 4:39486
ARGON 40 REACTIONS/MULTIPLE PRODUCTION
Multipion production in nuclear collisions, 4:39934 (LBL-8758)
ARGON IONS/COLLISIONS
Application of matrix isolation spectroscopy to the measurement of sputtering yields, 4:39098
Preferential sputtering of Ta_2O_5 by argon ions, 4:39776
Sputtering of two-phase polycrystalline metals, 4:39777
ARGON IONS/DESORPTION
Ion and electron desorption of neutral molecules from stainless steel (304), 4:40025
ARGON IONS/ION-MOLECULE COLLISIONS
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu (Preliminary cross sections, electron pickup and loss, 3.4 to 8.5 MeV/amu), 4:39795 (LBL-8932)
ARGONNE ZGS
See ZGS
ARID LANDS
See also DESERTS
ARID LANDS/SOLAR ENERGY
Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper, 4:38358 (PB-285129)
ARID LANDS/WATER RESOURCES
Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper, 4:38358 (PB-285129)
ARIZONA/MAGNETIC SURVEYS
Airborne gamma-ray spectrometer and magnetometer survey: Prescott Quadrangle (Arizona). Final report, 4:38219 (GJBX-59(79)(Vol.2)(Prescott))
Airborne gamma-ray spectrometer and magnetometer survey: Williams Quadrangle (Arizona). Final report, 4:38220 (GJBX-59(79)(Vol.2)(Williams))
ARIZONA/RADIOMETRIC SURVEYS
Airborne gamma-ray spectrometer and magnetometer survey: Prescott Quadrangle (Arizona). Final report, 4:38219 (GJBX-59(79)(Vol.2)(Prescott))
Airborne gamma-ray spectrometer and magnetometer survey: Williams Quadrangle (Arizona). Final report, 4:38220 (GJBX-59(79)(Vol.2)(Williams))
ARKANSAS/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ARKANSAS/GEOTHERMAL EXPLORATION
Geothermal exploration methods and results: inland states, 4:38519 (LA-UR-79-665)
ARKANSAS/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ARKANSAS/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ARMY PERSONNEL
See MILITARY PERSONNEL
AROMATICS
See also TETRALIN
TOLUENE
AROMATICS/COMBUSTION KINETICS
Combustion kinetics of selected aromatic hydrocarbons. Interim report 1 Jun 77-13 May 78, 4:38174 (AD-A-059381)
ARSENIC/X-RAY FLUORESCENCE ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
ARTHROPODS
See also INSECTS
ARTHROPODS/ABUNDANCE
Distribution and abundance of soil arthropods in the northern Mojave desert, 4:39595 (UCLA-12-1190)
ARTHROPODS/DISTRIBUTION
Distribution and abundance of soil arthropods in the northern Mojave desert, 4:39595 (UCLA-12-1190)
ASHES
See also FLY ASH
ASHES/CATALYTIC EFFECTS
Conversion of forest residues to a methane-rich gas, 4:38322
ASHES/CHEMICAL ANALYSIS
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR-79/5)
ASHES/MASS SPECTROSCOPY
Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas, 4:38982 (CONF-781009-)
ASHES/PARTICLE SIZE
Techniques for measurement of ash droplet size in coal-fired MHD flows, 4:38966 (CONF-781009-)
ASHES/SAMPLING
Utilization of coal associated minerals. Quarterly report No. 2, January-March 1978, 4:38086 (FE-2721-2)
ASHES/WASTE DISPOSAL
Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB-284013)
ASTEROIDS/BIBLIOGRAPHIES
A bibliography of planetary geology principal investigators and their associates, 1976-1978, 4:39756 (N-78-28027)
ASTROCYTOMAS
See NEOPLASMS
ATMOSPHERIC EXPOSURE CHAMBERS
See EXPOSURE CHAMBERS
ATMOSPHERIC PRECIPITATIONS
See also FOG

ATMOSPHERIC PRECIPITATIONS/CHEMICAL COMPOSITION
Comparison of precipitation chemistry data at a central Illinois site in 1954 and in 1977, 4:39541 (COO-1199-54)
ATOM COLLISIONS
See also ELECTRON-ATOM COLLISIONS
ION-ATOM COLLISIONS
ATOM COLLISIONS/ENERGY TRANSFER
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978-May 31, 1979 (Summaries of research activities at Univ., Missouri), 4:39791 (COO-2718-7)
ATOMIC CLOUDS
See RADIOACTIVE CLOUDS
ATOMIC EXPLOSIONS
See NUCLEAR EXPLOSIONS
ATOMIC MODELS/SELF-CONSISTENT FIELD
Systematic determination of extended atomic orbital basis sets and application to molecular SCF and MCSCF calculations, 4:39801 (IS-T-852)
ATOMS/HAMILTONIANS
The evaluation of matrix elements with generalized spherical Gaussian wavefunctions Part I. Single-particle, one- and two-centre forms. Technical report no. 1, 1 May 77-31 Apr 78, 4:39800 (AD-A-059533)
ATOMS/HARMONIC OSCILLATOR MODELS
Analytic coherent states for generalized potentials, 4:39802 (LA-UR-79-218)
ATP
(Adenosine triphosphate.)
ATP/MEASURING METHODS
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR-3490-1480)
AUGER ELECTRON SPECTROSCOPY/COLLISIONS
H^+ and D^+ sputtering of thin tantalum films in the energy range of 0.6 to 15 keV, 4:39148
AUGER ELECTRON SPECTROSCOPY/CONTROL EQUIPMENT
Microcomputer-based multiplexer for performing depth profiling with an Auger electron spectrometer, 4:39774
AUGER ELECTRON SPECTROSCOPY/SAMPLE CHANGERS
Versatile UHV sample transfer system, 4:40022
AURORAL SUBSTORMS
See MAGNETIC BAYS
AUTOMOBILES/CATALYTIC CONVERTERS
Catalytic apparatus (Patent), 4:39081
Method of treating vehicle exhaust gas and catalyst used therein (Patent), 4:39086
Modeling of the catalytic converter for automotive exhaust gas, 4:39087
AUTOMOBILES/EXHAUST GASES
Analysis of timing and carburetion calibrations. Final report, 4:39056 (PB-283953)
AUTOMOBILES/FUEL ECONOMY
Analysis of production cars' fuel economy, 4:39023 (PB-283931)
Analysis of GM fuel economy surveys. Final report, 4:39024 (PB-283946)
Analysis of timing and carburetion calibrations. Final report, 4:39056 (PB-283953)
AUTOMOBILES/GAS TURBINES
Gas turbine (Patent), 4:39075
AUTOMOBILES/LEAD-ACID BATTERIES
Battery container having cast battery terminal formed therein (Patent), 4:38857
AUTOMOBILES/ROAD TESTS
Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in Chicago, Illinois. Final report, 4:39027 (PB-284941)
AUTOMOTIVE FUELS
See also GASOLINE
HYDROGEN FUELS
AUTOMOTIVE FUELS/PERFORMANCE
Generator gas: the Swedish experience from 1939-1945, 4:39090 (SERI/SP-33-140)
AUTORADIOGRAPHY
Examination of radioactive particles in WSGHWR coolant circuits using scanning electron microscope autoradiography, 4:38645

B

BACTERIA
See also ESCHERICHIA COLI
BACTERIA/NITROGEN FIXATION
Assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation, 4:38324 (N-78-30798)
BACTERIOPHAGES/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
BAG MODEL/GAUGE INVARIANCE
Quark confinement in unusual environments, 4:39875
BAG MODEL/QUANTUM CHROMODYNAMICS
Asymptotic freedom without guilt, 4:39872 (UH-511-329-79)
BAG MODEL/QUARKS
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BAG MODEL/VACUUM POLARIZATION
Vacuum-polarization-corrected long-distance static quark-antiquark potential, 4:39874
BARGES
See also SHIPS
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 4. Barge transport. Final report, 4:38113 (DOE/TIC-10053(Vol.4))
BARITE/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
BARITE/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
BARIUM/FLUORESCENCE
Laser induced fluorescence studies of the reactions of barium (^1S, ^3D) and strontium (^1S, ^3P) with halogenated methanes, 4:39251
BARIUM/PHOTOCHEMICAL REACTIONS
Laser induced fluorescence studies of the reactions of barium (^1S, ^3D) and strontium (^1S, ^3P) with halogenated methanes, 4:39251
BARIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
BARIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
BARIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
BARIUM COMPOUNDS/SPUTTERING
Radio-frequency-sputtered tetragonal barium titanate films on silicon, 4:39180
BARLEY/PRODUCTION
An energy analysis of Tasmanian barley, hops and beer production, 4:39033 (PB-283950)
BARYONS
See also NUCLEONS
BARYONS/BAG MODEL
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BARYONS/COLOR MODEL
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BARYONS/GLUON MODEL
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BARYONS/MAGNETIC MOMENTS
Comment on the magnetic moments of baryons in the broken-SU(6) -symmetry model, 4:39871
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BARYONS/MASS FORMULAE
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
BASALT/THERMODYNAMIC PROPERTIES
Thermal properties of Gable Mountain basalt cores, Hanford Nuclear Reservation (Thermal conductivity and diffusivity, specific heat, and density at RT and 200°C), 4:39725 (LBL-7038)
BATTERIES (ELECTRIC)
See ELECTRIC BATTERIES
BATTERY SEPARATORS/DESIGN
Galvanic cell having rechargeable zinc electrode (Patent; mechanical-chemical approach), 4:38853
BAY OF FUNDY/TIDAL POWER PLANTS
Review of optimization and economic evaluation of potential tidal power developments in the Bay of Fundy, 4:38555

BEAM BENDING MAGNETS/BEAM OPTICS
Study of a 90° bending magnet for H^- beams, 4:39405 (LA-UR-79-710)
BEAM DYNAMICS
(Particle beam motion inside an accelerator.)
See also ELECTRON COOLING
BEAM DYNAMICS/LIOUVILLE THEOREM
Are we beating Liouville's theorem, 4:39415 (LBL-7574)
BEAM DYNAMICS/TRANSFER MATRIX METHOD
Method of transfer maps for linear and nonlinear beam elements, 4:39402 (LA-UR-79-699)
BEAM INJECTION HEATING/NEUTRAL BEAM SOURCES
Properties of an intense 40-kV neutral beam injector, 4:40011
BEAM TRANSPORT/SPACE CHARGE
Role of space charge in beam transport, 4:39398
BEAM TRANSPORT/STEADY-STATE CONDITIONS
Steady state transport of high current beams in a focused channel. Interim report, 4:39770 (AD-A-059882)
BEAM-PLASMA SYSTEMS/FLUTE INSTABILITY
High frequency stability of field-reversed ion rings in a background plasma, 4:39987 (N-78-28941)
BEES
See INSECTS
BELGIAN REACTOR 2
See BR-2 REACTOR
BENZOPYRENE/BIOLOGICAL EFFECTS
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
Transformations of C3H 10T1/2 cells by Benzo(a)pyrene and subsequent attempts at suppression of transformed foci by untransformed cells and Vitamin A (Alpha particles), 4:39686 (ANL-78-65(Pt.2))
BENZOPYRENE/MUTAGENESIS
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
BERYLLIUM/AUGER ELECTRON SPECTROSCOPY
High-resolution LMM Auger spectra from argon implanted in Be and Si, 4:39153
BERYLLIUM/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
BERYLLIUM/PION MINUS REACTIONS
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
BERYLLIUM 7/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
BERYLLIUM 7/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
BERYLLIUM 7/REMOVAL
Control of beryllium-7 in liquid lithium, 4:40013 (HEDL-SA-1594-FP)
BERYLLIUM ISOTOPES/NUCLEOSYNTHESIS
Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50-90 MeV, 4:39895
BERYLLIUM MODERATORS
See BERYLLIUM
BERYLLIUM OXIDES/SURFACE COATING
Analysis of coatings and thin films using energetic ions, 4:39177 (SAND-79-2076C)
BETA BACKSCATTERING GAGES
See RADIOMETRIC GAGES
BEVALAC/BEAM MONITORING
Computed tomographic reconstruction of beam profiles with a multi-wire chamber, 4:39459 (LBL-8947)
BEVALAC/BEAM MONITORS
Secondary emission monitors at the Bevatron-Bevalac, 4:39457 (LBL-8808)
BEVATRON
(6.2-GeV proton synchrotron at LBL.)
BEVATRON/BEAM MONITORS
Secondary emission monitors at the Bevatron-Bevalac, 4:39457 (LBL-8808)
BEVERAGES/PRODUCTION
An energy analysis of Tasmanian barley, hops and beer production, 4:39033 (PB-283950)
BIBLIOGRAPHIES
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB-285628)
BI-GAS PROCESS/BENCH-SCALE EXPERIMENTS
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
BI-GAS PROCESS/CATALYSTS
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
BI-GAS PROCESS/HAZARDS
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
BI-GAS PROCESS/PILOT PLANTS
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
BI-GAS PROCESS/PROCESS DEVELOPMENT UNITS
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
BINARY ALLOY SYSTEMS/FCC LATTICES
Monte Carlo study of an ordering alloy on an fcc lattice, 4:39949
BINARY ALLOY SYSTEMS/MONTE CARLO METHOD
Monte Carlo study of an ordering alloy on an fcc lattice, 4:39949
BINARY STARS/COSMIC X-RAY SOURCES
Discovery of iron line emission in the Hercules X-1 low-state spectrum with HEAO-1, 4:39740 (N-78-31038)
High energy x-ray spectra of Cygnus XR-1 observed from OSO-8, 4:39742 (N-78-32017)
BINARY STARS/MASS TRANSFER
High energy x-ray spectra of Cygnus XR-1 observed from OSO-8, 4:39742 (N-78-32017)
BIOLOGICAL MATERIALS
(See also specific biological materials.)
See also BIOMASS
BLOOD
MILK
PLANTS
TISSUES
URINE
BIOLOGICAL MATERIALS/SEDIMENTATION
Preliminary report. R/V Thomas G. Thompson cruise TT-122 (Phytoplankton distribution and organic matter sedimentation rate data collected off of Washington Coast), 4:39611 (DOE/EV-75027-58)
BIOLOGICAL PATHWAYS/COMPARATIVE EVALUATIONS
Biological solar energy conversion approaches to overcome yield stability and product limitations. Progress report no. 6, 1 October 1977-31 March 1978, 4:39555 (PB-284823)
BIOMASS
(All growing organic matter such as plants, trees, grasses, and algae.)
See also AGRICULTURAL WASTES
ALGAE
MAIZE
MANURES
PLANTS
SEAWEEDS
TREES
WOOD WASTES
BIOMASS/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
BIOMASS/MEETINGS
Energy from biomass and wastes, 4:38400
Increased energy from biomass: 1985 possibilities and problems. Working papers for planners, 4:38399 (RLO-78-5)
BIOMASS PLANTATIONS/OFFSHORE OPERATIONS
Review of the energy from Marine Biomass Program, 4:38320
BIOMASS PLANTATIONS/PLANNING
Review of the energy from Marine Biomass Program, 4:38320
BIOMASS PLANTATIONS/RESEARCH PROGRAMS
Review of the energy from Marine Biomass Program, 4:38320
BIOMASS PLANTATIONS/SITE SELECTION
Eucalyptus Energy Farms as a renewable source of fuel, 4:38401
BIOMEDICAL RADIOGRAPHY/RADIATION DOSES
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB-285628)
Reduction of patient dose delivered by CHR diagnostic x-ray examinations, 4:39661 (ANL-78-65(Pt.2))
BIOMEDICAL RADIOGRAPHY/RADIATION HAZARDS
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB-285628)
BISMUTH/CHEMISORPTION
Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
BISMUTH 208/ENERGY LEVELS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
BITUMINOUS COAL/CHEMICAL ANALYSIS
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR-79/5)
BITUMINOUS COAL/CHEMICAL COMPOSITION
SEM observations and EDX analyses of secondary mineralization in a bituminous coal, 4:38082 (CONF-790418-4)

BITUMINOUS COAL/PYROLYSIS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
BITUMINOUS MATERIALS
See also OIL SANDS
OIL SHALES
BITUMINOUS MATERIALS/REFINING
Substantiation of the technological principles for working bituminous fields of Tataria, 4:38198
BLACK COATINGS/THERMAL DEGRADATION
Relationship of optical degradation to surface morphology changes in solar absorbers, 4:38502
BLACK HOLES/BARYON NUMBER
Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
BLACK SHALES/EXPLOSIVE FRACTURING
Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, July-September 1978, 4:38191 (FE-2346-34)
BLACK SHALES/IN-SITU COMBUSTION
Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, July-September 1978, 4:38191 (FE-2346-34)
BLACK SHALES/PHYSICAL PROPERTIES
Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, July-September 1978, 4:38191 (FE-2346-34)
BLANKETS (BREEDING)
See BREEDING BLANKETS
BLASTS
See EXPLOSIONS
BLOOD
See also BLOOD CELLS
BLOOD/RADIONUCLIDE KINETICS
Blood content and excretory plasma clearance of plutonium 10^4 days after injection (^{239}Pu), 4:39687 (ANL-78-65(Pt.2))
BLOOD CELLS
See also ERYTHROCYTES
BLOOD CELLS/CFU
Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
BLOOD CELLS/PATHOLOGICAL CHANGES
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
BLOOD COAGULATION FACTORS
See also FIBRINOGEN
BLOOD COAGULATION FACTORS/BIOCHEMICAL REACTION KINETICS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
BLOOD COAGULATION FACTORS/BIOSYNTHESIS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
BLOWDOWN/DYNAMIC LOADS
Structural dynamic analysis of BWR MARK II plant under SRV blowdown oscillation, 4:38804 (INIS-mf-4492)
BNL
(Brookhaven National Laboratory.)
BNL/VAN DE GRAAFF ACCELERATORS
Major improvements at Brookhaven since the beginning, 4:39371 (LA-7445-C)
BOILERS/AIR POLLUTION
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
BOILERS/CORROSION PROTECTION
Boiler corrosion (citations from the NTIS data base). Report for 1964-August 1978, 4:38582 (NTIS/PS-78/0993)
Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76, 4:38584 (NTIS/PS-78/0994/SL)
Boiler corrosion. volume 2. 1975-1976 (citations from the engineering index data base). Report for 1975-76, 4:38583 (NTIS/PS-78/0994)
Boiler corrosion. volume 3. 1977-august, 1978 (citations from the engineering index data base). Report for 1977-August 1978, 4:38585 (NTIS/PS-78/0995)
BOILERS/ENVIRONMENTAL EFFECTS
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
BOILERS/MATERIALS
Materials, 4:39165
BOILING DETECTION
Boiling detection in fast reactors by noise analysis studies performed in France, 4:38695
BOILING WATER REACTORS
See BWR TYPE REACTORS
BOLTS
See FASTENERS
BONE MARROW/HISTOLOGICAL TECHNIQUES
Improved histochemical methods for the examination of plastic-embedded human marrow, 4:39650 (UR-3490-1553)
BONE MARROW CELLS/BIOCHEMICAL REACTION KINETICS
Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
BONE MARROW CELLS/CFU
Competition between erythropoietin and colony-stimulating factor for target cells in mouse marrow, 4:39640
BONE MARROW CELLS/DELAYED RADIATION EFFECTS
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL-25730)
BONE MARROW CELLS/PATHOLOGICAL CHANGES
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
BONE TISSUES/BIOLOGICAL RADIATION EFFECTS
Analysis of thick source alpha particle spectrum from radium and its daughters in bone (^{226}Ra, ^{214}Po), 4:39678 (ANL-78-65(Pt.2))
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
BONE TISSUES/DATA COMPILATION
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
BONE TISSUES/OSTEOSARCOMAS
Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship (^{226}Ra, ^{239}Pu), 4:39675 (ANL-78-65(Pt.2))
BONE TISSUES/RADIOCHEMICAL ANALYSIS
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
BONES
See SKELETON
BOOKKEEPING
See ACCOUNTING
BOR-60 REACTOR/PRIMARY COOLANT CIRCUITS
Radioactivity of long-lived nuclides in the primary circuit of the reactor BOR-60 during operation with defective fuel elements, 4:38682 (KFK-tr-576)
BORATES/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
BORATES/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
BOREHOLES/PLUGGING
Use of polymers for isolating flows of impure water, 4:38149
BOREHOLES/TESTING
Study of boreholes by the use of a seam tester on tubes with surface gas emission, 4:38154
BORON/CHEMICAL VAPOR DEPOSITION
Large-area boron and carbon scatterers and filters, 4:39187 (UCID-18077)
BORON 10 TARGET/NEUTRON REACTIONS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
Summary documentation for ^{10}B (1 keV to 1 MeV), 4:39893 (LA-7663-MS)
BORON 11 REACTIONS/ELASTIC SCATTERING
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
BORON ALLOYS/ELECTROCHEMICAL CORROSION
Experimental application of design principles in corrosion research, 4:39183
BORON CARBIDES/PHYSICAL RADIATION EFFECTS
BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME-78-103)
BORON CHLORIDES/OXIDATION
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)

BORON FLUORIDES/OXIDATION
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
BORON IONS/COLLISIONS
K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4-3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
BORON ISOTOPES/NUCLEOSYNTHESIS
Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50-90 MeV, 4:39895
BORON NITRIDES/ABLATION
Boron nitride ablation studies in arc jet facilities, 4:39179 (SAND-79-0413C)
BR-2 REACTOR/LEADING ABSTRACT
BR2 reactor review meeting, Mol June 1, 1978. Tool for advanced nuclear research. Results and perspective of joint Belgo-German reactor utilization, 4:38781 (INIS-mf-4426)
BR-2 REACTOR/REACTOR EXPERIMENTAL FACILITIES
Irradiation techniques at BR2 reactor, 4:38782 (INIS-mf-4426)
BR-2 REACTOR/REACTOR OPERATION
General outline of the operation and utilization of the BR2 reactor, 4:38783 (INIS-mf-4426)
BRASIMONE PEC REACTOR
See PEC BRASIMONE REACTOR
BRAYTON CYCLE POWER SYSTEMS/RADIOISOTOPE HEAT SOURCES
Preliminary design study of an alternate heat source assembly for a Brayton isotope power system. Final report, October 1977-April 1978, 4:38306 (N-78-28608)
BRAZIL/LABORATORY EQUIPMENT
Laboratory instruments, (Brazil). Foreign market survey report, 4:39487 (DIB-78-12-501)
BRAZIL/NUCLEAR POWER
Social and economic impact of nuclear energy in Brazil. A structural analysis with a generalized input-output model, 4:38894 (INIS-mf-4521)
BREAKERS (CIRCUIT)
See CIRCUIT BREAKERS
BREATH/SAMPLING
Postprandial changes in the exhalation of radon from the environment, 4:39579 (ANL-78-65(Pt.2))
BREATHING
See BREATH
BREEDER REACTORS
See also ACCELERATOR BREEDERS
GCFR TYPE REACTORS
LMFBR TYPE REACTORS
BREEDER REACTORS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
BREEDER REACTORS/PIPES
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
BREEDER REACTORS/RADIOACTIVE EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
BREEDER REACTORS/THERMAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
BREEDING BLANKETS/DESIGN
MIT LMFBR blanket research project. Quarterly progress report, October 1-December 31, 1978, 4:38665 (COO-2250-35)
Tokamak reactors and structural materials, 4:40007 (UWFDM-288)
BREEDING BLANKETS/HYDROGEN PRODUCTION
One- and two-dimensional heating analyses of fusion synfuel blankets, 4:40005 (BNL-NUREG-25635)
BREMSSTRAHLUNG (MAGNETIC)
See SYNCHROTRON RADIATION
BRINES/CHEMICAL COMPOSITION
Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL-52640)
BRINES/SCALING
Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL-52640)
BROMINATED ALIPHATIC HYDROCARBONS
Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL-82181)
BROMINATED ALIPHATIC HYDROCARBONS/ATOM-MOLECULE COLLISIONS
Molecular beam studies of unimolecular reactions: Cl, F + C_3H_5Br (Angular and velocity distributions, mechanism), 4:39794 (LBL-7686)
BROMINATED ALIPHATIC HYDROCARBONS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
BROMINE/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
BROMINE/ION COLLISIONS
K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4-3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
BROMINE CHLORIDES/TOXICITY
Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB-286113)
BROOKHAVEN AGS
(Alternating-Gradient Synchrotron.)
BROOKHAVEN AGS/BEAM EXTRACTION
1.5 GeV/c multiturn shaving extraction and its transport line for the Brookhaven AGS, 4:39429 (BNL-25784)
BROOKHAVEN AGS/BEAM MONITORS
Tests of a new secondary emission chamber at the AGS (Extracted beam intensity), 4:39435 (BNL-25795)
BROOKHAVEN AGS/BEAM TRANSPORT
Beam transfer from the AGS to ISABELLE, 4:39469 (BNL-25783)
High field superconducting beam transport in a BNL primary proton beam, 4:39436 (BNL-25796)
BROOKHAVEN AGS/MULTIPARTICLE SPECTROMETERS
MPS configuration and performance characteristics, 4:39433 (BNL-25311)
BROOKHAVEN AGS/SUPERCONDUCTING MAGNETS
High field superconducting beam transport in a BNL primary proton beam, 4:39436 (BNL-25796)
BROOKHAVEN NATIONAL LABORATORY
See BNL
BUILDING MATERIALS
See also CONCRETES
A study of the feasibility of utilizing solid wastes for building materials. phase iii and iv summary reports. Final report, September 1975-March 1978, 4:39046 (PB-285437)
BUILDINGS
See also APARTMENT BUILDINGS
COMMERCIAL BUILDINGS
EARTH-COVERED BUILDINGS
GREENHOUSES
HOSPITALS
HOUSES
RESIDENTIAL BUILDINGS
SCHOOL BUILDINGS
BUILDINGS/AIR CONDITIONING
Heat pump system with improved heat transfer (Patent), 4:39002
JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings, 4:38996 (N-78-31541)
BUILDINGS/AIR INFILTRATION
Indoor air quality in energy-efficient buildings, 4:38995 (LBL-8892)
BUILDINGS/AIR QUALITY
Indoor air quality in energy-efficient buildings, 4:38995 (LBL-8892)
BUILDINGS/COOLING LOAD
JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings, 4:38996 (N-78-31541)
BUILDINGS/ENERGY CONSERVATION
National energy plan: energy conservation with insulation. Final report, 4:38993 (HIT-689)
Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings, 4:38470 (LBL-7811)
BUILDINGS/HEATING LOAD
JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings, 4:38996 (N-78-31541)
BUILDINGS/HEATING SYSTEMS
Building heating system (Patent), 4:38997
BUILDINGS/SEISMIC EFFECTS
Trip report: UCSB earthquake damage survey (August 13, 1978 event), 4:39711 (SLAC-TN-79-1)
BUILDINGS/SOLAR AIR CONDITIONING
Solar space heating and air conditioning. volume 2. 1976-august, 1977 (citations from the NTIS data base). Report for 1976-August 1977, 4:38475 (NTIS/PS-78/1014)
Solar space heating and air conditioning. volume 3. September, 1977-september, 1978 (citations from the ntis data base). Report

for September 1977-September 1978, 4:38476 (NTIS/PS-78/1015)
Solar space heating and air conditioning. volume 3. September, 1977-September, 1978 (citations from the Engineering Index data base). Report for sep 77-sep 78, 4:38477 (NTIS/PS-78/1017)
BUILDINGS/SOLAR SPACE HEATING
Solar space heating and air conditioning. volume 2. 1976-august, 1977 (citations from the NTIS data base). Report for 1976-August 1977, 4:38475 (NTIS/PS-78/1014)
Solar space heating and air conditioning. volume 3. September, 1977-september, 1978 (citations from the ntis data base). Report for September 1977-September 1978, 4:38476 (NTIS/PS-78/1015)
Solar space heating and air conditioning. volume 3. September, 1977-September, 1978 (citations from the Engineering Index data base). Report for sep 77-sep 78, 4:38477 (NTIS/PS-78/1017)
BUILDINGS/SPACE HEATING
Heat pump system with improved heat transfer (Patent), 4:39002
BUILDINGS/THERMAL INSULATION
National energy plan: energy conservation with insulation. Final report, 4:38993 (HIT-689)
BUILDINGS/VENTILATION
Indoor air quality in energy-efficient buildings, 4:38995 (LBL-8892)
BUILDINGS/WASTE HEAT UTILIZATION
Run-around type energy recovery system (Patent), 4:39001
BUILDINGS (CONTAINMENT)
See CONTAINMENT BUILDINGS
BURNERS
See also COMBUSTORS
FLUIDIZED-BED COMBUSTORS
BURNERS/FUEL SUBSTITUTION
Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 2, Kiln Burner (From natural gas to low Btu gas), 4:38123 (FE-2489-27)
BURNERS/PERFORMANCE TESTING
Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 2, Kiln Burner (From natural gas to low Btu gas), 4:38123 (FE-2489-27)
BURNERS/POLLUTION CONTROL EQUIPMENT
Process and apparatus for controlled recycling of combustion gases (Patent), 4:39349
BUTENES/ELECTRON COLLISIONS
Electron impact spectra of some mono-olefinic hydrocarbonsa), 4:39775
BUTYLENES
See BUTENES
BWR TYPE REACTORS
See also DRESDEN-1 REACTOR
TARAPUR-1 REACTOR
TARAPUR-2 REACTOR
Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits, 4:38628
BWR TYPE REACTORS/BLOWDOWN
Structural dynamic analysis of BWR MARK II plant under SRV blowdown oscillation, 4:38804 (INIS-mf-4492)
BWR TYPE REACTORS/CONTAINMENT SHELLS
Effects of torus wall flexibility on forces in the Mark I boiling water reactor pressure suppression system. Final report, 4:38821 (NUREG/CR-0746)
BWR TYPE REACTORS/FUEL ELEMENTS
Fuel performance improvement program. Quarterly progress report October-December 1978, 4:38624 (COO-4066-9)
BWR TYPE REACTORS/FUEL RODS
FFRS: A computer program for the thermal and mechanical analysis of fuel rods, 4:38627 (RISO-373)
BWR TYPE REACTORS/GASEOUS WASTES
Monitoring of airborne releases from LWR power plants in the Federal Republic of Germany, 4:38777
BWR TYPE REACTORS/LEAK DETECTORS
On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany, 4:38629
BWR TYPE REACTORS/LOOSE PARTS MONITORING
On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany, 4:38629
BWR TYPE REACTORS/LOSS OF COOLANT
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978, 4:38817 (NUREG/CR-0698)
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
BWR TYPE REACTORS/MELTDOWN
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978, 4:38817 (NUREG/CR-0698)
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978, 4:38816 (NUREG/CR-0697)
Steam explosion triggering and efficiency studies, 4:38823 (SAND-78-0261C)
BWR TYPE REACTORS/NOZZLES
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf-4506)
BWR TYPE REACTORS/PRESSURE VESSELS
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf-4506)
BWR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978, 4:38816 (NUREG/CR-0697)
BWR TYPE REACTORS/RADIATION MONITORING
Development of a monitoring device for noble gas nuclides in the stack effluent of a BWR nuclear power plant, 4:38735
BWR TYPE REACTORS/REACTOR ACCIDENTS
Modeling vertical loads in pools resulting from fluid injection, 4:38829
Two-phase flow phenomena in nuclear reactor technology. Quarterly progress report No. 10, September-November 1978, 4:38818 (NUREG/CR-0702)
BWR TYPE REACTORS/REACTOR PROTECTION SYSTEMS
LLL field test systems division support to the U.S. Nuclear Regulatory Commission. FY 1978 progress report, 4:38827 (UCRL-52708)
BWR TYPE REACTORS/STACK DISPOSAL
Determination of the physico-chemical species of radioiodine in the stack discharge of nuclear power plants, 4:38762 (KFK-EXT-30/78-1)

C

CACTACEAL
See CACTI
CACTI/POPULATION DYNAMICS
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
CACTI/SPECIES DIVERSITY
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
CADMIUM/ADSORPTION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
CADMIUM/METALLURGICAL EFFECTS
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
CADMIUM/PRECIPITATION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
CADMIUM/X-RAY FLUORESCENCE ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
CADMIUM 109/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
CADMIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CADMIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CADMIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CADMIUM SULFIDE SOLAR CELLS/SURFACE COATING
Formation of thin Cu_2S (chalcocite) films using reactive sputtering techniques, 4:38394
CALCIUM/BIOLOGICAL EFFECTS
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL-78-65(Pt.2))
CALCIUM/DATA COMPILATION
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))

CALCIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
Spectral method for determining impurities in anthracite and oil coke, 4:38084
CALCIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
CALCIUM/RADIOCHEMICAL ANALYSIS
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
CALCIUM 40 TARGET/BORON 11 REACTIONS
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
CALCIUM 40 TARGET/CARBON 12 REACTIONS
Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca, 4:39905
CALCIUM 40 TARGET/ELASTIC SCATTERING
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
CALCIUM 40 TARGET/PICKUP REACTIONS
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
CALCIUM 40 TARGET/PION MINUS REACTIONS
π^+ and π^- elastic scattering from ^{40}Ca at 65 MeV (Differential cross sections, preliminary results), 4:39903 (LA-UR-79-839)
CALCIUM 40 TARGET/PION PLUS REACTIONS
π^+ and π^- elastic scattering from ^{40}Ca at 65 MeV (Differential cross sections, preliminary results), 4:39903 (LA-UR-79-839)
CALCIUM 40 TARGET/PROTON REACTIONS
Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
CALCIUM 42 TARGET/CARBON 12 REACTIONS
Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca, 4:39905
CALCIUM 44 TARGET/PROTON REACTIONS
Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
CALCIUM 48 TARGET/CARBON 12 REACTIONS
Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca, 4:39905
CALCIUM 48 TARGET/PROTON REACTIONS
Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
CALCIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CALCIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CALCIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CALCIUM COMPOUNDS/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
CALCIUM OXIDES/CATALYTIC EFFECTS
Conversion of forest residues to a methane-rich gas, 4:38322
CALCIUM OXIDES/CRYSTAL STRUCTURE
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341-2)
CALCIUM OXIDES/ELECTRICAL PROPERTIES
Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009-)
CALCIUM OXIDES/ORDER-DISORDER TRANSFORMATIONS
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341-2)
CALHOUN-1 REACTOR/ACTIVITY LEVELS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
CALHOUN-1 REACTOR/CONTAINMENT BUILDINGS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
CALIFORNIA/EARTHQUAKES
Trip report: UCSB earthquake damage survey (August 13, 1978 event), 4:39711 (SLAC-TN-79-1)
CALIFORNIA/ENERGY POLICY
State energy management: The California Energy Resources Conservation and Development Commission. (innovations transfer: new approaches by the states), 4:38921 (PB-285062)
CALIFORNIA/ENERGY SHORTAGES
Natural gas shortage. Final report, 4:38178 (PB-283875)
CALIFORNIA/LEGISLATION
Report to the legislature on the constitutionality of California's nuclear laws, 4:38895 (PB-285131)
CALIFORNIA/POWER DEMAND
Final environmental impact report on the long range energy program for the California State Water Project. Final report, 4:38876 (PB-283822)
CALIFORNIA/WATER RESOURCES
Final environmental impact report on the long range energy program for the California State Water Project. Final report, 4:38876 (PB-283822)
CALIFORNIUM 249 TARGET/DEUTERON REACTIONS
Electric monopole transitions and excited 0^+ states in ^{250}Cf, 4:39920
CALIFORNIUM 250/E0-TRANSITIONS
Electric monopole transitions and excited 0^+ states in ^{250}Cf, 4:39920
CALIFORNIUM 250/ENERGY LEVELS
Electric monopole transitions and excited 0^+ states in ^{250}Cf, 4:39920
CALIFORNIUM 251 TARGET/NEUTRON REACTIONS
Calculation of prompt fission neutron spectra, 4:39917 (LA-7722-PR)
CALORIMETERS/FEASIBILITY STUDIES
Feasibility of a Mound-designed transportable calorimeter, 4:38292 (MLM-2603)
CAMAC SYSTEM
(Computer Application to Measurement And Control.)
CAMAC SYSTEM/USES
Single-crate stand-alone CAMAC control system for a negative ion source test facility, 4:39426 (CONF-790327-10)
CANADA/MINING LAWS
Mining in canada--a taxing experience, 4:38873
CANADA/TAXES
Mining in canada--a taxing experience, 4:38873
CANCER
See NEOPLASMS
CANDU TYPE REACTORS
See also DOUGLAS POINT ONTARIO REACTOR
PICKERING-1 REACTOR
CANDU TYPE REACTORS/COOLANT CLEANUP SYSTEMS
Development of the CANDU heat transport purification system design philosophy, 4:38646
Graphite beds for coolant filtration at high temperature, 4:38648
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
CANDU TYPE REACTORS/DECONTAMINATION
Decontamination experience at CANDU-PHW reactors, 4:38650
Optimization of decontamination strategy for CANDU-PHW reactors, 4:38659
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
CANDU TYPE REACTORS/PRIMARY COOLANT CIRCUITS
High flow, high temperature magnetic filtration of the primary heat transport coolant of the CANDU power reactors, 4:38653
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
CANDU TYPE REACTORS/REACTOR CONTROL SYSTEMS
Spatial power control in large CANDU reactors: the whys and wherefores, 4:38751 (AECL-6212)
CANDU TYPE REACTORS/STEAM GENERATORS
Chemical control and design considerations for CANDU-PHW steam generators, 4:38647
CANDU TYPE REACTORS/STEAM SYSTEMS
Growth of radiation fields around CANDU boilers, 4:38652
CANDU TYPE REACTORS/WATER CHEMISTRY
Water chemistry of CANDU PHW reactors, 4:38651
CANONICAL EQUATIONS
See DIFFERENTIAL EQUATIONS
CARBON
See also ACTIVATED CARBON
GRAPHITE
CARBON/AMORPHOUS STATE
Amorphous carbon and its structural relationship to amorphous silicon and germanium, 4:39952
CARBON/CHEMICAL VAPOR DEPOSITION
Large-area boron and carbon scatterers and filters, 4:39187 (UCID-18077)

CARBON/DEPOSITION
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
CARBON/ENVIRONMENTAL EFFECTS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
CARBON/GASIFICATION
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
CARBON/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)
CARBON/ION COLLISIONS
Temperature dependence of alignment production in He I by beam-foil excitation, 4:39778
CARBON/ION-ATOM COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
CARBON/MOLECULE-MOLECULE COLLISIONS
Carbon reaction studied by crossed molecular beams), 4:39786
CARBON/PHOTONUCLEAR REACTIONS
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
CARBON/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
CARBON 11/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
CARBON 12/ENERGY LEVELS
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)
Origin of gross structure in ^{12}C + ^{12}C and ^{16}O + ^{16}O inelastic scattering, 4:39886
CARBON 12/HYPERNUCLEI
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)
CARBON 12 REACTIONS/BORON 11 REACTIONS
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
CARBON 12 REACTIONS/COMPOUND-NUCLEUS REACTIONS
Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ ≃ 14.3 and 25.2 MeV, 4:39891
CARBON 12 REACTIONS/ELASTIC SCATTERING
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
Surface transparency in ^{12}C elastic scattering from /sup 40,42,48/Ca, 4:39905
CARBON 12 REACTIONS/INELASTIC SCATTERING
Origin of gross structure in ^{12}C + ^{12}C and ^{16}O + ^{16}O inelastic scattering, 4:39886
CARBON 12 REACTIONS/PICKUP REACTIONS
Comparison of the single-proton pick-up reactions calcium 40(boron 11, carbon 12)potassium 39 and calcium 40(carbon 13, nitrogen 14)potassium 39 (Angular distribution, partial waves), 4:39902 (INIS-mf-4427)
CARBON 12 TARGET/CARBON 12 REACTIONS
Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ ≃ 14.3 and 25.2 MeV, 4:39891
Origin of gross structure in ^{12}C + ^{12}C and ^{16}O + ^{16}O inelastic scattering, 4:39886
CARBON 12 TARGET/KAON MINUS REACTIONS
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)
CARBON 12 TARGET/NEUTRON BEAMS
Neutron physics at LASL, 4:39378
CARBON 12 TARGET/PION PLUS REACTIONS
Low energy π^+ scattering from light nuclei, 4:39896
CARBON 12 TARGET/PION REACTIONS
Effect of short-range correlations in the second order pion-carbon optical potential (Differential and total cross sections, 40 to 280 MeV, pion propagator effects), 4:39889
CARBON 12 TARGET/PROTON REACTIONS
Spallation of aluminum by 300 GeV protons, 4:39901
CARBON 14/RADIOACTIVE WASTE DISPOSAL
Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976, 4:38251 (IAEA-209)
CARBON 14/RECOVERY
Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report, 4:38243 (IDO-1540-T1)
CARBON DIOXIDE/ADSORPTION
Interactions of gases with coal: structural inferences, 4:38081 (CONF-790415-26)
CARBON DIOXIDE/DIELECTRIC PROPERTIES
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA-7445-C)
CARBON DIOXIDE/ENVIRONMENTAL EFFECTS
Ecosystem Studies Program, 4:39615 (ORNL-5508)
CARBON DIOXIDE LASERS/CATHODES
Life test results for an ensemble of CO^2 lasers, 4:39290 (N-78-27404)
CARBON DIOXIDE LASERS/DESIGN
Optical resonance pumped transfer laser with high multiline photon-to-single-line photon conversion efficiency (Patent), 4:39298
CARBON DIOXIDE LASERS/EFFICIENCY
Possibility of building a gasdynamic laser utilizing transitions between levels of paired CO_2 modes, 4:39306
CARBON DIOXIDE LASERS/OPTICAL PUMPING
Blackbody optical pumping of carbon dioxide laser mixtures, 4:39323
CARBON DIOXIDE LASERS/PERFORMANCE
Characteristics of a distributed feedback carbon dioxide laser, 4:39324
CARBON DIOXIDE LASERS/REVIEWS
Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77, 4:39284 (AD-A-059429)
CARBON DIOXIDE LASERS/SYNCHRONIZATION
Synchronization of electron-beam-controlled CO_2 lasers with a plasma mirror, 4:39311
CARBON DIOXIDE LASERS/USES
Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77, 4:39284 (AD-A-059429)
CARBON IONS/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
CARBON MONOXIDE/ADSORPTION
ELS vibrational study of carbon monoxide adsorbed on the Cu(110) surface, 4:39149
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
CARBON MONOXIDE/CHEMICAL REACTION KINETICS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
CARBON MONOXIDE/INVENTORIES
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)
CARBON MONOXIDE/METHANATION
Catalytic synthesis of hydrocarbons, 4:38316 (LBL-8975)
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
CARBON MONOXIDE/MONITORING
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
CARBON MONOXIDE/OXIDATION
Catalytic reactions on well characterized surfaces by ac techniques, 4:39223 (LBL-8975)
CARBON MONOXIDE/QUANTITATIVE CHEMICAL ANALYSIS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)
CARBON STEELS
See also STEEL-ASTM-A106
CARBON STEELS/CLEANING
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
CARBON STEELS/CRACKS
Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures, 4:39118 (INIS-mf-4506)

CARBON STEELS/FRACTURE PROPERTIES
Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures, 4:39118 (INIS-mf-4506)
CARBON SULFIDES/PHOTOIONIZATION
Photoionization mass spectrometric studies of selected compounds in a molecular beam, 4:39793 (LA-7727-T)
CARBON TETRAFLUORIDE/INFRARED SPECTRA
High-resolution spectroscopy measurements of the $^{12}CF_4$ $\nu_2 + \nu_4$ band at 9 μm, 4:39237 (LA-7542)
CARBONACEOUS MATERIALS
See also BITUMINOUS MATERIALS
CARBONACEOUS MATERIALS/IN-SITU PROCESSING
Method for producing hydrocarbons from igneous sources (Patent; using subterranean heat), 4:38317
CARBONYLS/SYNTHESIS
Synthesis and characterization of the mixed-metal alkylidyne clusters RcFeCo2(CO)9h (r = CH3, C2H5, C6H5). Interim technical report, 4:39216 (AD-A-058229)
CARBURETORS/CALIBRATION
Analysis of timing and carburetion calibrations. Final report, 4:39056 (PB-283953)
CARCINOGENESIS/SYNERGISM
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415-31)
CARCINOMAS/RADIOINDUCTION
Dose-response relationships for female radium dial workers (^{226}Ra, ^{228}Ra), 4:39673 (ANL-78-65(Pt.2))
Recent cases of radium-induced malignancy, 4:39671 (ANL-78-65(Pt.2))
CARDIOVASCULAR SYSTEM/PATHOLOGICAL CHANGES
Changes in the electrocardiograms of rats and dogs exposed to dc magnetic fields, 4:39702 (LBL-9085)
CARIBOU
See DEER
CATALYSIS/HYDROGEN TRANSFER
Heterogeneous catalysis and surface chemistry, 4:39231 (LBL-8975)
CATALYSIS/MEETINGS
Heterogeneous catalysis research meeting, 4:39238 (LBL-8975)
CATALYST SUPPORTS/SYNTHESIS
Supported catalysts: synthesis and characterization, 4:39227 (LBL-8975)
CATALYSTS/CHEMICAL COMPOSITION
Characterization of CO + H_2 catalysts for production of light hydrocarbons, 4:38315 (LBL-8975)
CATALYSTS/COMPARATIVE EVALUATIONS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)
CATALYSTS/DEACTIVATION
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, August 1, 1978-October 31, 1978, 4:38057 (FE-2229-11)
CATALYSTS/DESORPTION
Analysis of chemistry at ionically bonded surfaces by electron stimulated desorption(a), 4:39225 (LBL-8975)
CATALYSTS/ELECTRONIC STRUCTURE
Theoretical studies of the electronic structure and bonding properties of surfaces, 4:39228 (LBL-8975)
CATALYSTS/EVALUATION
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, August 1, 1978-October 31, 1978, 4:38057 (FE-2229-11)
CATALYSTS/MORPHOLOGY
Properties of supported metal catalysts, 4:39226 (LBL-8975)
CATALYSTS/PERFORMANCE TESTING
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
CATALYSTS/POISONING
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
Auger and reaction studies of poisoning by sulfur and regeneration of metal synthesis gas catalysts, 4:38312 (LBL-8975)
CATALYSTS/RECOVERY
Exxon catalytic coal gasification process: predevelopment program. Annual report, July 1976-June 1977, 4:38058 (FE-2369-20)
CATALYSTS/REGENERATION
Auger and reaction studies of poisoning by sulfur and regeneration of metal synthesis gas catalysts, 4:38312 (LBL-8975)
CATALYSTS/SERVICE LIFE
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
Gas Generator Research and Development: BI-GAS process. Quarterly report, July-September 1978, 4:38050 (FE-1207-53)
CATALYSTS/SORPTIVE PROPERTIES
ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions, 4:39224 (LBL-8975)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
CATALYSTS/SURFACE PROPERTIES
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
CATALYSTS/SYNTHESIS
Supported catalysts: synthesis and characterization, 4:39227 (LBL-8975)
CATALYTIC CONVERTERS/DESIGN
Catalytic apparatus (Patent), 4:39081
Method of treating vehicle exhaust gas and catalyst used therein (Patent), 4:39086
CATALYTIC CONVERTERS/MATHEMATICAL MODELS
Modeling of the catalytic converter for automotive exhaust gas, 4:39087
CATALYTIC CONVERTERS/PERFORMANCE TESTING
Catalytic control of NO/sup x/ demonstration. Final report, 4:39088 (PB-284095)
CATALYTIC CONVERTERS/REGENERATION
Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas (Patent), 4:39355
CATALYTIC CONVERTERS/SUPPORTS
Elastic mounting for a catalytic converter in an internal combustion engine (Patent), 4:39082
CATARACTS/RADIOINDUCTION
Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968-December 31, 1978J (X radiation), 4:39668 (COO-2012-38)
CATHODES/SERVICE LIFE
Life test results for an ensemble of CO^2 lasers, 4:39290 (N-78-27404)
CELLS (ANIMAL)
See ANIMAL CELLS
CELLS (BACTERIAL)
See BACTERIA
CELLULOSE/THERMOCHEMICAL PROCESSES
Mechanism of conversion of cellulosic wastes to liquid fuels in alkaline solution, 4:38319
CEPHEIDS/COLOR
Variable star research at Los Alamos, 4:39731 (LA-UR-78-3089)
CEPHEIDS/HERTZSPRUNG-RUSSELL DIAGRAM
Variable star research at Los Alamos, 4:39731 (LA-UR-78-3089)
CERAMICS
High temperature materials requirements of the magnetohydrodynamic energy conversion, 4:38972
CERAMICS/DEGASSING
UHV compatibility of two possible fusion reactor materials: K-ramic/sup R/ and ATJ graphite, 4:40023
CERIUM 144/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
CERIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CERIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CERIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
CERMETS/MATERIALS TESTING
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
CERN II SYNCHROTRON
See CERN SPS SYNCHROTRON
CERN SPS SYNCHROTRON/COLLIDING BEAMS
Design study of a proton-anti proton colliding beam facility. Appendix B, 4:39456 (LBL-7574)
Proposed p-anti p colliding beam facility at CERN, 4:39411 (LBL-7574)

CESIUM/DIFFUSION
Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA-1543-FP)
CESIUM/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
CESIUM 137/BIOLOGICAL ACCUMULATION
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
CESIUM 137/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
CESIUM 141/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
CFRMF REACTOR/NEUTRON SPECTRA
Coupled Fast Reactivity Measurements Facility (CFRMF), 4:38779 (IAEA-208(Vol.2))
CFRMF REACTOR/SPECIFICATIONS
Coupled Fast Reactivity Measurements Facility (CFRMF), 4:38779 (IAEA-208(Vol.2))
CHARM PARTICLES
See also CHARMED BARYON RESONANCES
CHARMED MESON RESONANCES
D RESONANCES
CHARM PARTICLES/DECAY
Lecture III. Production of charm (Cross sections, lecture, review), 4:39833 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/LECTURES
Lectures on charmed particles, 4:39853 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/MASS
Lecture III. Production of charm (Cross sections, lecture, review), 4:39833 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/MASS SPECTRA
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/PARTICLE IDENTIFICATION
Search for short-lived particles in high-energy neutrino interactions identified using a hybrid emulsion-spark-chamber arrangement, 4:39821
CHARM PARTICLES/PARTICLE PRODUCTION
Search for short-lived particles in high-energy neutrino interactions identified using a hybrid emulsion-spark-chamber arrangement, 4:39821
CHARM PARTICLES/PARTICLE PROPERTIES
Lecture I. Introduction to charm (Lecture), 4:39854 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/PRODUCTION MECHANISMS
Lecture III. Production of charm (Cross sections, lecture, review), 4:39833 (FERMILAB-CONF-78/37-THY)
CHARM PARTICLES/QUARK MODEL
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARMED BARYON RESONANCES/MASS SPECTRA
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARMED BARYON RESONANCES/PARTICLE PRODUCTION
Charmed-baryon production in electron-positron annihilation, 4:39844
CHARMED BARYON RESONANCES/PARTICLE PROPERTIES
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARMED BARYON RESONANCES/QUARK MODEL
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARMED MESON RESONANCES/MASS SPECTRA
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
CHARMED MESON RESONANCES/PARTICLE PROPERTIES
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
CHARMED MESON RESONANCES/PARTICLE STRUCTURE
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
CHARMED MESON RESONANCES/QUARK MODEL
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
CHARMONIUM
Vacuum-polarization-corrected long-distance static quark-antiquark potential, 4:39874
CHARS/CHEMICAL COMPOSITION
Mechanism of conversion of cellulosic wastes to liquid fuels in alkaline solution, 4:38319
CHARS/CORROSIVE EFFECTS
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
CHARS/YIELDS
Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1-June 30, 1978, 4:38080 (FE-MIT-2295T26-6)
CHEMICAL ANALYSIS
See also NONDESTRUCTIVE ANALYSIS
NUCLEAR REACTION ANALYSIS
RADIOCHEMICAL ANALYSIS
CHEMICAL ANALYSIS/AUTOMATION
Automating the Analytical Laboratories Section, Lewis Research Center, National Aeronautics and Space Administration: a feasibility study, 4:39204 (UCRL-52594)
CHEMICAL ANALYSIS/QUALITY ASSURANCE
Environmental radioactivity laboratory intercomparison studies program, 1978-1979. Interim report, 4:39209 (PB-284850)
CHEMICAL EFFLUENTS/AIR POLLUTION
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
CHEMICAL EFFLUENTS/CHEMICAL COMPOSITION
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
CHEMICAL EFFLUENTS/ENVIRONMENTAL IMPACTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
CHEMICAL EFFLUENTS/WATER POLLUTION
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
CHEMICAL EXPLOSIONS/ELECTROMAGNETIC PULSES
H.E. EMP: The "HASH", 4:39520 (UCID-18165)
CHEMICAL EXPLOSIVES/DETONATIONS
M-3 Series on Detonation Science. II. One-dimensional flow, 4:39516 (LA-7817-MS(Vol.2))
CHEMICAL EXPLOSIVES/PERFORMANCE
Calculation of explosive rock breakage: oil shale, 4:38188 (LA-UR-79-646)
CHEMICAL EXPLOSIVES/STABILITY
Thermally stable, plastic-bonded explosives (Patent), 4:39521
CHEMICAL EXPLOSIVES/TENSILE PROPERTIES
Mechanical properties of LX-10-1 evaluated with the diametric disc test, 4:39517 (MHSMP-79-8)
CHEMICAL INDUSTRY
See also MINERAL INDUSTRY
CHEMICAL INDUSTRY/CHEMICAL EFFLUENTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
CHEMICAL INDUSTRY/ENERGY CONSUMPTION
Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States, 4:39040 (HCP/M5056-02)
CHEMICAL INDUSTRY/WASTE HEAT UTILIZATION
Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States, 4:39040 (HCP/M5056-02)
CHEMICAL LASERS
Investigation of group IV-A metal vapor generation and flux behavior. Final report, 4:39283 (AD-A-058306)
CHEMICAL LASERS/CHAIN REACTIONS
Chain-reaction chemical lasers for the visible range, 4:39305
CHEMICAL LASERS/ENERGY YIELD
Investigation of a pulsed chemical H_2-F_2 laser at high pressures of the working mixture, 4:39314
Investigation of the energy parameters of a chemical ClF-H_2 laser with electron-beam initiation, 4:39318
CHEMICAL LASERS/FEASIBILITY STUDIES
Advanced laser concepts. Final report, 4:39285 (AD-A-059811)
CHEMICAL LASERS/GAIN
Gain measurement in a supersonic jet utilizing a $D+O_2+CO_2$ mixture, 4:39317

CHEMICAL LASERS/OPERATION
Investigation of a pulsed chemical H_2-F_2 laser at high pressures of the working mixture, 4:39314
CHEMICAL LASERS/OPTICAL PUMPING
Utilization of excited atoms in thermally initiated chemical lasers in the visible range, 4:39304
CHEMICAL LASERS/OPTIMIZATION
Influence of photoinitiating substances on stimulated emission from a chemical HF laser, 4:39315
CHEMICAL LASERS/STIMULATED EMISSION
Influence of photoinitiating substances on stimulated emission from a chemical HF laser, 4:39315
CHEMICAL LASERS/SUPERSONIC FLOW
Gain measurement in a supersonic jet utilizing a $D+O_2+CO_2$ mixture, 4:39317
CHEMICAL REACTORS/DESIGN
Biological denitrification of industrial strength nitrate wastes, 4:39049 (Y/DA-8220)
Conversion of forest residues to a methane-rich gas, 4:38322
CHEMICAL REACTORS/FLUIDIZED BED
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)
CHEMICAL REACTORS/GEOTHERMAL HEATING
Method for using geothermal energy (Patent), 4:38551
CHEMISORPTION
(Dissolution or adsorption followed by chemical reaction.)
CHEMISORPTION/AUGER ELECTRON SPECTROSCOPY
Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
CHEMISORPTION/ELECTRON DIFFRACTION
Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
CHEMISORPTION/ELECTRON LOSS
Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
CHEMISTRY
See also RADIATION CHEMISTRY
RADIOCHEMISTRY
CHEMISTRY/MEETINGS
Bumnentagung 1978, 4:39220 (AED-Conf-78-150-004)
CHERENKOV RADIATION/BIOLOGICAL RADIATION EFFECTS
Visual phenomena induced by relativistic carbon ions with and without Cerenkov radiation, 4:39666
CHI-3500 RESONANCES/PAIR PRODUCTION
Production of photons associated with the psi by 217-GeV/cπp mesons, 4:39825
CHI-3500 RESONANCES/PARTICLE PRODUCTION
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
CHLORIDES/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
CHLORINATED ALIPHATIC HYDROCARBONS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
CHLORINE/ATOM-MOLECULE COLLISIONS
Molecular beam studies of unimolecular reactions: Cl, F + C_2H_5Br (Angular and velocity distributions, mechanism), 4:39794 (LBL-7686)
CHLORINE/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
CHLORINE/TOXICITY
Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB-286113)
CHLORINE BROMIDES
See BROMINE CHLORIDES
CHONDROSARCOMAS
See SARCOMAS
CHROMATES/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
CHROMATES/MICROSTRUCTURE
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
CHROMATES/SEED-SLAG INTERACTIONS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
CHROMIUM/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
CHROMIUM/CHEMICAL STATE
Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL-8975)
CHROMIUM/MATERIALS TESTING
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
CHROMIUM/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
CHROMIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
CHROMIUM ALLOYS
See also CHROMIUM STEELS
CHROMIUM-NICKEL STEELS
CHROMIUM ALLOYS/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
CHROMIUM ALLOYS/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
CHROMIUM ALLOYS/CORROSION PROTECTION
Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
CHROMIUM ALLOYS/CRACKS
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
CHROMIUM ALLOYS/FRACTURE PROPERTIES
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
CHROMIUM ALLOYS/STRESS ANALYSIS
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
CHROMIUM STEELS
(Steels containing only chromium as alloying element; see also CHROMIUM-NICKEL STEELS.)
CHROMIUM STEELS/CREEP
Strain range partitioning in cyclic creep of a 1Cr-Mo-V steel, 4:39141
CHROMIUM STEELS/FATIGUE
Strain range partitioning in cyclic creep of a 1Cr-Mo-V steel, 4:39141
CHROMIUM-NICKEL STEELS
(Steels containing Cr and Ni; the Ni content is usually 0.5 to 2.0%, the Cr content is higher.)
STAINLESS STEEL-304
See also STAINLESS STEEL-304L
STAINLESS STEEL-308
STAINLESS STEEL-310
STAINLESS STEEL-316
High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat, 4:39143
CHROMIUM-NICKEL STEELS/RESIDUAL STRESSES
Estimation of residual stresses in reactor pressure vessel steel specimens clad by stainless steel strip electrodes, 4:39132
Measurement of residual stresses in claddings, 4:39131
CHROMODYNAMICS
See QUANTUM CHROMODYNAMICS
CHROMOSOMAL ABERRATIONS/RADIOINDUCTION
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
CIRCUIT BREAKERS/ELECTRICAL INSULATION
Fundamental techniques for gas-insulated apparatus, 4:38618
CLAMS
See MOLLUSCS
CLAYS
See also ILLITE
MONTMORILLONITE
CLAYS/GAMMA LOGGING
Determining the composition of sand-clay soils from polarization potentials and gamma logging, 4:39515
CLAYS/SP LOGGING
Determining the composition of sand-clay soils from polarization potentials and gamma logging, 4:39515
CLINCH RIVER BREEDER REACTOR/STEAM GENERATORS
Welding for the CRBRP steam generators, 4:38667 (GEFR-SP-151)
CLINTON P ANDERSON MESON PHY. FACILITY
See LAMPF LINAC
CLOTHES DRYERS/DESIGN
Solar supplement to laundry drying. Annual progress report, October 31, 1977-October 31, 1978, 4:38486 (COO-4517-1)
COAL
See also ANTHRACITE
BITUMINOUS COAL

COAL GASIFICATION
COAL LIQUEFACTION
LIGNITE

COAL/AIR POLLUTION
Terrestrial Ecology Section, 4:38091 (ORNL-5508)

COAL/ALKYLATION
Coal anion structure and chemistry of coal alkylation. Sixth quarterly progress report, June 1-August 31, 1978, 4:38083 (COO-4227-6)

COAL/CHEMICAL ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)

COAL/CHEMICAL COMPOSITION
Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1-June 30, 1978, 4:38080 (FE-MIT-2295T26-6)

COAL/CHEMICAL REACTIONS
Coal anion structure and chemistry of coal alkylation. Sixth quarterly progress report, June 1-August 31, 1978, 4:38083 (COO-4227-6)

COAL/COMBUSTION PRODUCTS
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)

COAL/CONSUMPTION RATES
Short term coal demand model. Final report, 4:38127 (DOE/TIC-10089)

COAL/DESULFURIZATION
Advanced development of fine coal desulfurization and recovery technology. Annual technical progress report, October 1, 1977-September 30, 1978, 4:38044 (IS-4668)
Coal desulfurization using microwave energy. Final report, August 1976-October 1977, 4:38045 (PB-285880)

COAL/DISSOLUTION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)

COAL/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)

COAL/FLUIDIZED-BED COMBUSTION
Carbonaceous fuel combustion with improved desulfurization (Patent), 4:38608
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N-78-28225)
Industrial application of fluidized-bed combustion. Quarterly technical progress report, October-December 1978 (Georgetown University project progress), 4:38124 (HCP/T2461-10)
Proceedings of the fifth international conference on fluidized bed combustion. Volume 1: overview, 4:38125 (M-78-68(Vol.1))

COAL/FORECASTING
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))

COAL/HYDRAULIC TRANSPORT
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 3. Coal slurry pipelines. Final report, 4:38112 (DOE/TIC-10053(Vol.3))
Water pollution control for coal slurry pipelines. Final report, 4:38121 (SAI-068-79-516)

COAL/HYDROCARBONS
Water pollution control for coal slurry pipelines. Final report, 4:38121 (SAI-068-79-516)

COAL/HYDROGENATION
Deuterium tracer method for investigating the chemistry of coal liquefaction. Quarterly technical progress report, April-June 1978, 4:38076 (FE-2781-3)
Process for liquefying coal (Patent), 4:38079

COAL/LAND TRANSPORT
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 6. Truck haulage. Final report, 4:38115 (DOE/TIC-10053(Vol.6))

COAL/MARKET
Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report, 4:38129 (PB-285944)

COAL/MATERIALS HANDLING
Coal cutter vehicle (Patent; unloading coal), 4:38122

COAL/OXIDATION
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)

COAL/PNEUMATIC TRANSPORT
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 7. Pneumatic transport. Final report, 4:38116 (DOE/TIC-10053(Vol.7))

COAL/PYROLYSIS
Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1-June 30, 1978, 4:38080 (FE-MIT-2295T26-6)

COAL/RAIL TRANSPORT
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 8. Yellow ball rail. Final report (Uses of salvage cars and old track as a gathering system for small mines), 4:38117 (DOE/TIC-10053(Vol.8))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 2. Unit trains. Final report, 4:38111 (DOE/TIC-10053(Vol.2))

COAL/REDUCTION
Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415-25)

COAL/SOLID WASTES
Earth Sciences, 4:38087 (ORNL-5508)

COAL/SOLVENT EXTRACTION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)

COAL/SORPTIVE PROPERTIES
Interactions of gases with coal: structural inferences, 4:38081 (CONF-790415-26)

COAL/STORAGE
Source assessment: coal storage piles. Final task report May 1974-September 1975 (Atmospheric emissions), 4:38092 (PB-284297)

COAL/STRUCTURAL MODELS
Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415-25)

COAL/THERMODYNAMIC PROPERTIES
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)

COAL/TRANSPORT
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 1. Summary and conclusions. Final report, 4:38110 (DOE/TIC-10053(Vol.1))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 4. Barge transport. Final report, 4:38113 (DOE/TIC-10053(Vol.4))
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 5. Conveyor belts. Final report, 4:38114 (DOE/TIC-10053(Vol.5))
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)

COAL DEPOSITS/COMPARATIVE EVALUATIONS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)

COAL DEPOSITS/LEASING
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)

COAL FINES/DEASHING
Recovering fine-size coal from Alabama underground mine washer wastes using the Humphreys spiral, 4:38119 (FE-9005-T1)

COAL FINES/RECOVERY
Advanced development of fine coal desulfurization and recovery technology. Annual technical progress report, October 1, 1977-September 30, 1978, 4:38044 (IS-4668)
Recovering fine-size coal from Alabama underground mine washer wastes using the Humphreys spiral, 4:38119 (FE-9005-T1)

COAL GAS/ECONOMICS
Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report, 4:38129 (PB-285944)

COAL GASIFICATION
See also BI-GAS PROCESS
IN-SITU GASIFICATION
Processing of lignite for petrochemicals (Patent), 4:38069

COAL GASIFICATION/BENCH-SCALE EXPERIMENTS
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)

COAL GASIFICATION/CATALYSTS
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, August 1, 1978-October 31, 1978, 4:38057 (FE-2229-11)

Vibrational spectroscopic studies of coal conversion catalysts, 4:38065 (LBL-8975)
COAL GASIFICATION/CHEMICAL EFFLUENTS
Synthetic Fuels Program, 4:38090 (ORNL-5508)
COAL GASIFICATION/CHEMICAL REACTIONS
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)
COAL GASIFICATION/ENTRAINMENT
Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 6, 1 July 1978-30 September 1978, 4:38067 (TID-28953)
COAL GASIFICATION/MIXING
Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 6, 1 July 1978-30 September 1978, 4:38067 (TID-28953)
COAL GASIFICATION/MONITORING
Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB-284041)
COAL GASIFICATION/PILOT PLANTS
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
COAL GASIFICATION PLANTS/AIR POLLUTION
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
COAL GASIFICATION PLANTS/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
COAL GASIFICATION PLANTS/DEMONSTRATION PLANTS
Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7, 4:38051 (FE-1775-18)
COAL GASIFICATION PLANTS/DESIGN
Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7, 4:38051 (FE-1775-18)
Preliminary design services: research and development report No. 114. Final report, 4:38052 (FE-1775-21)
COAL GASIFICATION PLANTS/ENVIRONMENTAL IMPACTS
Computer-aided analysis of coal gasification pilot plant data bases, 4:38060 (FE-2496-26)
COAL GASIFICATION PLANTS/EQUIPMENT
Department of Energy fossil energy equipment development programs, 4:38048 (CONF-790405-14)
COAL GASIFICATION PLANTS/FUEL FEEDING SYSTEMS
Coal feeder development. Phase II report, 4:38054 (FE-1793-46)
COAL GASIFICATION PLANTS/MATERIALS
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, April 1, 1978-June 30, 1978 (Corrosion tests of numerous alloys at high temperature, etc.), 4:38053 (FE-1784-42)
COAL GASIFICATION PLANTS/MATERIALS TESTING
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, April 1, 1978-June 30, 1978 (Corrosion tests of numerous alloys at high temperature, etc.), 4:38053 (FE-1784-42)
COAL GASIFICATION PLANTS/SITE SELECTION
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
COAL GASIFICATION PLANTS/WATER POLLUTION CONTROL
Future needs and the impact on the water and waste quipment manufacturing industry due to the use of synthetic fuels, 4:38085 (EPA-600/7-78-063)
COAL INDUSTRY
See also MINERAL INDUSTRY
COAL INDUSTRY/ENVIRONMENTAL EFFECTS
Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB-284013)
COAL LIQUEFACTION
See also POTT-BROCHE PROCESS
Mineral matter effects and catalyst characterization in coal liquefaction. Annual report, October 1977-September 1978, 4:38078 (SAND-79-0505)
Process for liquefying coal (Patent), 4:38079
COAL LIQUEFACTION/BENCH-SCALE EXPERIMENTS
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)
Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). First quarter report, April 1-June 30, 1978, 4:38075 (FE-2307-38)
COAL LIQUEFACTION/CATALYSTS
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)
Vibrational spectroscopic studies of coal conversion catalysts, 4:38065 (LBL-8975)
COAL LIQUEFACTION/CHEMICAL EFFLUENTS
Synthetic Fuels Program, 4:38090 (ORNL-5508)
COAL LIQUEFACTION/CHEMISTRY
Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415-25)
Deuterium tracer method for investigating the chemistry of coal liquefaction. Quarterly technical progress report, April-June 1978, 4:38076 (FE-2781-3)
COAL LIQUEFACTION PLANTS/AIR POLLUTION
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
COAL LIQUEFACTION PLANTS/DESIGN
Preliminary design services: research and development report No. 114. Final report, 4:38052 (FE-1775-21)
COAL LIQUEFACTION PLANTS/EQUIPMENT
Department of Energy fossil energy equipment development programs, 4:38048 (CONF-790405-14)
COAL LIQUEFACTION PLANTS/SITE SELECTION
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
COAL LIQUEFACTION PLANTS/WATER POLLUTION CONTROL
Future needs and the impact on the water and waste quipment manufacturing industry due to the use of synthetic fuels, 4:38085 (EPA-600/7-78-063)
COAL LIQUIDS/CATALYTIC CRACKING
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
COAL LIQUIDS/CHEMICAL ANALYSIS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
COAL LIQUIDS/DEASHING
Separation of particles from coal-derived liquids via surface charge properties. Quarterly progress report, September 15, 1977-December 15, 1977 (Electrofilters), 4:38072 (COO-4324-T1)
COAL LIQUIDS/DESULFURIZATION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
COAL LIQUIDS/ECONOMICS
Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report, 4:38129 (PB-285944)
COAL LIQUIDS/FRACTIONATION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
COAL LIQUIDS/HYDROGENATION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
Process for liquefying coal (Patent), 4:38079
COAL LIQUIDS/REDUCTION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
COAL LIQUIDS/REFINING
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)
COAL LIQUIDS/SOLVENT EXTRACTION
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)

COAL MINERS/LIFE SUPPORT SYSTEMS
Testing program for mining coal in an oxygen free atmosphere. Volume 1. Final report, 4:38103 (PB-285122)
COAL MINES/AIR POLLUTION MONITORS
Development of an improved methane sampling system. Open file report, 4:38132 (PB-286006)
COAL MINES/DUSTS
Dynamic particle size measurement of coal dust. Final report, 1 October 1973-30 November 1976, 4:38102 (PB-285096)
COAL MINES/HAZARDOUS MATERIALS
Materials suitable for use inside explosion-proof enclosures. Final report, 7 September 1975-7 March 1976, 4:38131 (PB-283972)
COAL MINES/ROOFS
Mine roof support method and apparatus (Patent), 4:38106
COAL MINING
See also LONGWALL MINING
SURFACE MINING
UNDERGROUND MINING
COAL MINING/LIFE-CYCLE COST
A life-cycle description of underground coal mining. Interim technical report, 4:38097 (N-78-28586)
COAL MINING/LONGWALL MINING
Design, fabrication and field testing of remotely operated longwall head/tail supports. Final report, 4:38101 (PB-285041)
COAL MINING/ROOF BOLTS
Roof bolting hazard analysis study. Final report, 1 July 1976-30 June 1977, 4:38099 (PB-284016)
COAL MINING/SOCIO-ECONOMIC FACTORS
Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB-283809)
COAL PREPARATION
Effects of minerals on coal beneficiation processes. Quarterly report No. 3, April 1-June 30, 1978, 4:38118 (FE-2722-3)
COAL PREPARATION PLANTS/ECONOMIC ANALYSIS
An engineering/economic analysis of coal preparation plant operation and cost. Final report, 4:38120 (PB-285251)
COAL TAR/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
COAL TAR/YIELDS
Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1-June 30, 1978, 4:38080 (FE-MIT-2295T26-6)
COAL-DERIVED LIQUIDS
See COAL LIQUIDS
COAL-FIRED MHD GENERATORS/AIR HEATERS
MHD downstream gas management, 4:38962 (CONF-781009-)
COAL-FIRED MHD GENERATORS/ASHES
Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas, 4:38982 (CONF-781009-)
Techniques for measurement of ash droplet size in coal-fired MHD flows, 4:38966 (CONF-781009-)
COAL-FIRED MHD GENERATORS/BOILERS
MHD downstream gas management, 4:38962 (CONF-781009-)
COAL-FIRED MHD GENERATORS/BOTTOMING CYCLES
Coal-fired MHD power generation: including balance of plant, 4:38950 (CONF-781009-)
COAL-FIRED MHD GENERATORS/COMBUSTION CHAMBERS
Combustion chambers for MHD power plants, 4:38960 (CONF-781009-)
COAL-FIRED MHD GENERATORS/ELECTRODES
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
COAL-FIRED MHD GENERATORS/MATERIALS
MHD downstream gas management, 4:38962 (CONF-781009-)
COAL-FIRED MHD GENERATORS/MATERIALS TESTING
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
COAL-FIRED MHD GENERATORS/MHD CHANNELS
Channel development for coal fired MHD, 4:38975 (CONF-781009-)
COAL-FIRED MHD GENERATORS/PERFORMANCE TESTING
Channel development for coal fired MHD, 4:38975 (CONF-781009-)
COAL-FIRED MHD GENERATORS/PLASMA DIAGNOSTICS
Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry, 4:38980 (CONF-781009-)
COAL-FIRED MHD GENERATORS/SEED RECOVERY
Coal-fired MHD power generation: including balance of plant, 4:38950 (CONF-781009-)
MHD downstream gas management, 4:38962 (CONF-781009-)
COAL-FIRED MHD GENERATORS/SLAGS
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
COAL-FIRED MHD GENERATORS/STEAM GENERATORS
MHD downstream gas management, 4:38962 (CONF-781009-)
COAST
See SHORES
COASTAL REGIONS/AIR POLLUTION
Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976-February 1977, 4:39563 (PB-285059)
COASTAL REGIONS/LAND POLLUTION CONTROL
Managing oil and gas activities in coastal environments, 4:38163 (PB-283677)
COASTAL REGIONS/PETROLEUM DEPOSITS
Managing oil and gas activities in coastal environments, 4:38163 (PB-283677)
COASTAL WATERS/BIOLOGICAL MATERIALS
Preliminary report. R/V Thomas G. Thompson cruise TT-122 (Phytoplankton distribution and organic matter sedimentation rate data collected off of Washington Coast), 4:39611 (DOE/EV-75027-58)
COASTAL WATERS/OIL POLLUTION CONTAINMENT
Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB-285646)
COASTAL WATERS/OIL SPILLS
Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB-285646)
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
COASTAL WATERS/PHYTOPLANKTON
Preliminary report. R/V Thomas G. Thompson cruise TT-122 (Phytoplankton distribution and organic matter sedimentation rate data collected off of Washington Coast), 4:39611 (DOE/EV-75027-58)
COASTAL ZONE MANAGEMENT ACT
Physical management of coastal floodplains: guidelines for hazards and ecosystems management. Report on task 1, 4:39594 (PB-284164)
COATED FUEL PARTICLES/FISSION PRODUCT RELEASE
Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures, 4:38809 (Juel-1490)
COATING (SURFACE)
See SURFACE COATING
COBALT/CATALYTIC EFFECTS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
COBALT/METALLURGICAL EFFECTS
Pulse plating of hard gold electrodeposits, 4:39101 (BDX-613-2165)
COBALT/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
COBALT 60/BIOLOGICAL ACCUMULATION
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
COBALT ALLOYS/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
COBALT ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
COBALT ALLOYS/SURFACE PROPERTIES
Characterization of CO + H_2 catalysts for production of light hydrocarbons, 4:38315 (LBL-8975)
COBALT COMPLEXES/SYNTHESIS
Synthesis and characterization of the mixed-metal alkylidyne clusters RcFeCo2(CO)9h (r = CH3, C2H5, C6H5). Interim technical report, 4:39216 (AD-A-058229)
COBALT OXIDES/CATALYTIC EFFECTS
Physical and catalytic properties of oxides, 4:39230 (LBL-8975)
COBALT OXIDES/ELECTRICAL PROPERTIES
Physical and catalytic properties of oxides, 4:39230 (LBL-8975)
CODING CIRCUITS
See DIGITAL CIRCUITS
COFFEE
See BEVERAGES
CO-GENERATION/FEASIBILITY STUDIES
Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1, 4:38566 (AD-A-057405)
COKE/CHEMICAL ANALYSIS
Spectral method for determining impurities in anthracite and oil coke, 4:38084

COKE OVENS/AIR POLLUTION ABATEMENT
Adjustable device for removing pollutants from gases and vapors evolved during coke quenching operations (Patent), 4:38088
COKE-OVEN GAS
See COAL GAS
COLLECTIVE ACCELERATORS
See also ELECTRON-RING ACCELERATORS
COLLECTIVE ACCELERATORS/BEAM DYNAMICS
Collective ion acceleration and intense electron beam propagation within an evacuated dielectric guide, 4:39390 (CONF-771035-P2)
Dielectric guide controlled collective ion acceleration, 4:39385 (CONF-771035-P2)
High intensity electron beam propagation between two plane conductors and its implications for collective ion acceleration, 4:39379 (AD-A-059337)
New collective particle accelerator, 4:39384 (CONF-771035-P2)
Theoretical and experimental investigations of the autoaccelerator, 4:39388 (CONF-771035-P2)
Wave accelerator for collective ion acceleration, 4:39382 (CONF-771035-P2)
COLLECTIVE ACCELERATORS/BEAM INJECTION
Collective ion acceleration and intense electron beam propagation within an evacuated dielectric guide, 4:39390 (CONF-771035-P2)
COLLECTIVE ACCELERATORS/CYCLOTRON RADIATION
Computational study of one aspect of autoresonant accelerator, 4:39400 (LA-UR-79-676)
COLLECTIVE ACCELERATORS/ENERGY SPECTRA
Collective ion acceleration in a vacuum diode, 4:39381 (CONF-771035-P2)
COLLECTIVE ACCELERATORS/PERFORMANCE
Collective ion acceleration in a vacuum diode, 4:39381 (CONF-771035-P2)
Linear beam collective ion acceleration for fusion applications, 4:39383 (CONF-771035-P2)
COLLECTIVE ACCELERATORS/SIMULATION
Computational study of one aspect of autoresonant accelerator, 4:39400 (LA-UR-79-676)
COLLECTIVE ACCELERATORS/TOROIDAL CONFIGURATION
Toroidal collective accelerator for heavy ions, 4:39391 (CONF-771035-P2)
COLLECTIVE ACCELERATORS/WAVE PROPAGATION
Wave accelerator for collective ion acceleration, 4:39382 (CONF-771035-P2)
COLLIERIES
See COAL MINES
COLOR MODEL/QUARK MODEL
Quasinuclear colored quark model for hadrons (Lectures), 4:39861 (FERMILAB-Conf-78/73-THY)
COLORADO/COAL DEPOSITS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
COLORADO/LAKES
Historical, physical, and chemical limnology of Twin Lakes, Colorado, 4:39632 (PB-283848)
COLUMBIUM
See NIOBIUM
COMBINED-CYCLE POWER PLANTS/CONTROL SYSTEMS
Method of operating a power plant and apparatus therefor (Patent), 4:38580
COMBINED-CYCLE POWER PLANTS/DEMONSTRATION PLANTS
Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7, 4:38051 (FE-1775-18)
COMBINED-CYCLE POWER PLANTS/DESIGN
Multi-process demonstration plant preliminary design/economic evaluation. R and D report No. 114, Interim report No. 7, 4:38051 (FE-1775-18)
COMBINED-CYCLE POWER PLANTS/GAS TURBINES
Development of high temperature turbine subsystem technology to a "technology readiness status", phase II. Progress report, March 1979, 4:38579 (FE-1806-65)
COMBINED-CYCLE POWER PLANTS/RELIABILITY
Influence of component redundancy on the availability of open cycle MHD power plants, 4:38947 (CONF-781009-)
COMBINED-CYCLE POWER PLANTS/REPAIR
Influence of component redundancy on the availability of open cycle MHD power plants, 4:38947 (CONF-781009-)
COMBUSTION
See also FLUIDIZED-BED COMBUSTION
IN-SITU COMBUSTION
COMBUSTION/MODIFICATIONS
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)
COMBUSTION CHAMBERS
See also COMBUSTORS
COMBUSTION CHAMBERS/DESIGN
Combustion chambers for MHD power plants, 4:38960 (CONF-781009-)
COMBUSTION PRODUCTS/AIR POLLUTION
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
COMBUSTION PRODUCTS/MASS SPECTROSCOPY
Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas, 4:38982 (CONF-781009-)
COMBUSTION PRODUCTS/PLASMA DIAGNOSTICS
Plasma luminosity fluctuations as a diagnostic tool, 4:38984
COMBUSTION PRODUCTS/WATER POLLUTION
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
COMBUSTORS
See also BURNERS
COMBUSTION CHAMBERS
COMBUSTORS/DESIGN
Fuels and combustion (For MHD generators), 4:38968
COMBUSTORS/MATERIALS
Materials, 4:39165
COMBUSTORS/RESEARCH PROGRAMS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
COMBUSTORS/TECHNOLOGY ASSESSMENT
Fuels and combustion (For MHD generators), 4:38968
COMETS/BIBLIOGRAPHIES
A bibliography of planetary geology principal investigators and their associates, 1976-1978, 4:39756 (N-78-28027)
COMMERCIAL BUILDINGS/AIR QUALITY
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
COMMERCIAL BUILDINGS/ENERGY CONSERVATION
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
National energy plan: energy conservation in lighting. Final report, 4:39014 (HIT-692)
National energy plan: energy conservation with heat pumps. Final report, 4:39013 (HIT-690)
COMMERCIAL BUILDINGS/ENERGY MANAGEMENT
Energy monitor and control system (Patent), 4:39015
COMMERCIAL BUILDINGS/LIGHTING SYSTEMS
National energy plan: energy conservation in lighting. Final report, 4:39014 (HIT-692)
COMMERCIAL BUILDINGS/PASSIVE SOLAR HEATING SYSTEMS
South-wall heating system for a commercial building employing tilt-up concrete construction, 4:38456 (CONF-780337-P3)
COMMERCIAL BUILDINGS/SPACE HEATING
National energy plan: energy conservation with heat pumps. Final report, 4:39013 (HIT-690)
COMMERCIAL BUILDINGS/VENTILATION
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
COMMERCIAL SECTOR/ENERGY CONSERVATION
Buildings energy management program workshop design. Final report, 4:39012 (CONS-8630-T1)
COMMERCIAL SECTOR/ENERGY CONSUMPTION
An annotated compilation of the sources of information related to the usage of electricity in non-industrial applications. Final report, 4:38931 (PB-285260)
COMMERCIAL SECTOR/ENERGY MANAGEMENT
Buildings energy management program workshop design. Final report, 4:39012 (CONS-8630-T1)
COMMUNITIES/ECONOMIC GROWTH
Action handbook for small communities facing rapid growth 'case study' Scobey, Montana. Final report, 4:38869 (PB-285870)
COMMUNITIES/PLANNING
Action handbook for small communities facing rapid growth 'case study' Scobey, Montana. Final report, 4:38869 (PB-285870)
COMMUNITIES (ECOLOGICAL)
See ECOSYSTEMS
COMPOSITE MATERIALS
See also CERMETS
COMPOSITE MATERIALS/TECHNOLOGY ASSESSMENT
Technology assessment of advanced composite materials. Phase I. Final report, 4:39171 (PB-283416)
COMPOUNDS (ORGANIC)
See ORGANIC COMPOUNDS

COMPUTER CALCULATIONS/ERRORS
Probabilistic error analysis of computer arithmetics, 4:40030 (COO-2280-37)
COMPUTER CODES
Activities of the Nuclear Energy Agency Computer program library, 4:38282
Description of data entry for automated cost estimating, 4:40035 (K/CSD/TM-29)
COMPUTER CODES/C CODES
COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis (LMFBR), 4:38685 (NUREG/CR-0785)
COMPUTER CODES/E CODES
EASYTBL: phototypeset tables for LASL reports, 4:40036 (LA-7633-M)
COMPUTER CODES/F CODES
FFRS: A computer program for the thermal and mechanical analysis of fuel rods, 4:38627 (RISO-373)
Finite element method for subsurface hydrology using a mixed explicit-implicit scheme, 4:39708
Primer and user manual for a Fortran Language Interactive Processor (FLIP) (In Fortran for IBM computers), 4:40033 (DOE/EIA-0103/25)
COMPUTER CODES/LEGAL ASPECTS
Discussion of session on reliability and warranty of numerical software, 4:40049 (DOE/TIC-10097)
COMPUTER CODES/M CODES
Multirate ordinary differential equation intergrator (MRATE, in FORTRAN for IBM 360/75, CYBER 175, and INTERDATA 7/32), 4:40031 (COO-2383-0056)
COMPUTER CODES/OPTIMIZATION
Implementation and testing of optimization software, 4:40034 (DOE/TIC-10096)
COMPUTER CODES/P CODES
Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores (PEBBLE code), 4:38641 (LA-7709-T)
User's manual for the compuer code PAREP, 4:38564 (SAND-79-0431)
COMPUTER CODES/R CODES
User's guide to the reactor inventory code RICE, 4:38725 (RD-B-N-4079)
COMPUTER CODES/T CODES
Anisotropic constitutive equation for use in finite difference wave propagation calculations (Incorporation into TOODY code), 4:39810 (SAND-79-0382)
Computer automation of continuous-flow analyzers for trace constituents in water. Volume 4. Description of program segments. Part 1. TAAIN (Technicon AutoAnalyzer), 4:39203 (UCRL-52532(Vol.4)(Pt.1))
Septum magnet coil design principles (Guide to using the computer code TRIM for coil design), 4:39445 (DOE/TIC-10045)
COMPUTER CODES/V CODES
Analysis of timing and carburetion calibrations. Final report (VEHSIM), 4:39056 (PB-283953)
COMPUTER LANGUAGES
See PROGRAMMING LANGUAGES
COMPUTER PROGRAMMING
See PROGRAMMING
COMPUTERS
See also PDP COMPUTERS
COMPUTERS/MEETINGS
3rd annual symposium on computer architecture (Clearwater, Florida, January 19-21, 1976), 4:40048
COMPUTERS/MEMORY DEVICES
Set-theoretic foundations of data-structure representation, 4:40044
COMPUTERS/PLANNING
Rocky Flats experience with SDM/70, 4:40041 (RFP-2902)
COMPUTERS/RESEARCH PROGRAMS
Courant Mathematics and Computing Laboratory, New York University. Progress report No. 54, October 1, 1977-September 30, 1978 (Courant Mathematics and Computing Laboratory, New York Univ.), 4:40032 (COO-3077-156)
CONCENTRATING COLLECTORS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
CONCENTRATING COLLECTORS/CERTIFICATION
Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report, 4:38489 (DOE/NASA/TM-78219)
CONCENTRATING COLLECTORS/COMPARATIVE EVALUATIONS
Summary report. Concentrating solar collector test results Collector Module Test Facility (CMTF), January-December 1978, 4:38497 (SAND-78-0977)
CONCENTRATING COLLECTORS/DESIGN
Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report, 4:38489 (DOE/NASA/TM-78219)
Solar collector subsystem preliminary design program. Final report, 4:38500 (SAND-78-7034)
CONCENTRATING COLLECTORS/PERFORMANCE TESTING
Development, testing, and certification of the Northrup, Inc., ML Series concentrating solar collector model NSC-01-0732. Final report, 4:38489 (DOE/NASA/TM-78219)
Summary report. Concentrating solar collector test results Collector Module Test Facility (CMTF), January-December 1978, 4:38497 (SAND-78-0977)
CONCRETES/QUALITY CONTROL
Development of a device for continuous automatic monitoring of consolidation of fresh concrete. Final report, 4:39497 (PB-285966)
CONCRETES/SORPTIVE PROPERTIES
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
CONDUCTORS (ELECTRIC)
See ELECTRIC CONDUCTORS
CONFERENCES
See MEETINGS
CONJUNCTIVA/PATHOLOGICAL CHANGES
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
CONNECTORS/ELECTRIC ARCS
Dielectric stimulated arcs in lightning arrestor connectors, 4:38614 (SAND-79-0396C)
CONSERVATION (RESOURCE)
See RESOURCE CONSERVATION
CONTACTORS
See SWITCHES
CONTAINMENT BUILDINGS
Study of the effect of hard projectiles impacting reinforced concrete walls, 4:38793 (CEA-CONF-4035)
CONTAINMENT BUILDINGS/RADIATION MONITORING
Determination of contamination in the air of reactor containment. Sampling and measuring techniques, 4:38738
CONTAINMENT BUILDINGS/SEISMIC EFFECTS
Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report, 4:39724 (EPRI-NP-920)
CONTAINMENT SHELLS/STRESS ANALYSIS
Effects of torus wall flexibility on forces in the Mark I boiling water reactor pressure suppression system. Final report, 4:38821 (NUREG/CR-0746)
CONTAINMENT SYSTEMS/PRESSURE SUPPRESSION
Modeling vertical loads in pools resulting from fluid injection, 4:38829
CONTAMINATION (SURFACE)
See SURFACE CONTAMINATION
CONTINENTAL SHELF/ENERGY SOURCE DEVELOPMENT
Attracting OCS related onshore facilities and activities: an assessment of prospects for New York state and their economic benefits, 4:38866 (PB-285197)
Marine related activities: an assessment of the economic impacts of OCS energy development, 4:38867 (PB-285198)
CONTROL EQUIPMENT/MICROPROCESSORS
Microcomputer-based multiplexer for performing depth profiling with an Auger electron spectrometer, 4:39774
CONTROL SYSTEMS
(For automated processes including feedback.)
See also ON-LINE CONTROL SYSTEMS
REACTOR CONTROL SYSTEMS
CONTROL SYSTEMS/DESIGN
Design package for programmable controller and hydronic subsystem, 4:38462 (DOE/NASA/CR-161151)
CONTROL SYSTEMS/PERFORMANCE
Design package for programmable controller and hydronic subsystem, 4:38462 (DOE/NASA/CR-161151)
CONTROL THEORY (REACTOR)
See REACTOR KINETICS
CONVERSION (NUCLEAR FUEL)
See NUCLEAR FUEL CONVERSION
CONVEYORS/MATERIALS
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 5. Conveyor belts. Final report, 4:38114 (DOE/TIC-10053(Vol.5))

CONVEYORS/OPTIMIZATION
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 5. Conveyor belts. Final report, 4:38114 (DOE/TIC-10053(Vol.5))
COOK INLET
See GULF OF ALASKA
COOLANT CLEANUP SYSTEMS
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
COOLANT CLEANUP SYSTEMS/FILTERS
Graphite beds for coolant filtration at high temperature, 4:38648
COOLANTS
(See also specific coolant materials.)
COOLANTS/PERFORMANCE
Nuclear performance of molten salt fusion-fission symbiotic systems for catalyzed DD and DT reactors, 4:40010 (ORNL/TM-6560)
COOLERS
See HEAT EXCHANGERS
COOLING PONDS/THERMODYNAMICS
Three-dimensional numerical model for hydrothermal analysis of cooling ponds, 4:39628
COOLING SYSTEM (REACTOR)
See REACTOR COOLING SYSTEMS
COOLING SYSTEMS
See also REACTOR COOLING SYSTEMS
COOLING SYSTEMS/ENVIRONMENTAL EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
COOLING TOWERS
See also MECHANICAL DRAFT COOLING TOWERS
NATURAL DRAFT COOLING TOWERS
Cooling tower plume research U.S. Environmental Protection Agency, 4:39589
COOLING TOWERS/CHEMICAL EFFLUENTS
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
Chalk Point Cooling Tower Project. Volume I, phase V. Analysis and archiving program, FY77. Final report, 1 July 1976-31 August 1977, 4:39556 (PB-284826)
COOLING TOWERS/DESIGN
Air radiator cooling tower (Patent), 4:38577
COOLING TOWERS/ENVIRONMENTAL EFFECTS
Basic concept of a prediction model for the cooling tower plume, 4:39591
Chalk Point cooling tower project: chalk point surface weather and ambient atmospheric profile data, September-December 1975, 4:39586 (PB-284211)
Chalk Point cooling tower project: Chalk Point surface weather and ambient atmospheric profile data; second intensive test period, June 14-24, 1976, 4:39587 (PB-284213)
Prediction methods of cooling tower plumes: Parts I-II, 4:39588
COOLING TOWERS/PERFORMANCE
Cooling towers, design and plume behavior, 4:38578
Standardized calculation of cooling towers (In German), 4:38573 (NP-23707)
COORDINATED RESEARCH PROGRAMS/DIRECTORIES
Who's Who III in the Interagency Energy/Environment R and D Program (Directory of EPA sponsored projects), 4:38892 (PB-284228)
COORDINATED RESEARCH PROGRAMS/MANAGEMENT
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB-284375)
COPEPODS/ENTRAINMENT
Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB-286113)
COPEPODS/MORTALITY
Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB-286113)
COPPER/ADSORPTION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
COPPER/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
COPPER/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
COPPER/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)
COPPER/ION COLLISIONS
K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4-3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
COPPER/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
COPPER/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
COPPER/PHOTONUCLEAR REACTIONS
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
COPPER/PHYSICAL RADIATION EFFECTS
Positron lifetime study of copper irradiated by energetic protons or energetic neutrons (24 and 14 MeV), 4:39169 (UCRL-82159)
COPPER/SORPTIVE PROPERTIES
ELS vibrational study of carbon monoxide adsorbed on the Cu(110) surface, 4:39149
COPPER/SURFACE PROPERTIES
Surface studies and catalysis , 4:39146 (LBL-8975)
COPPER ALLOYS/ANNEALING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
COPPER ALLOYS/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
COPPER ALLOYS/DEPOSITION
Deposition of aluminum-copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX-613-2173)
COPPER ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
COPPER ALLOYS/POSITRON CHANNELING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
COPPER ALLOYS/PRECIPITATION
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
COPPER ALLOYS/SURFACE PROPERTIES
Characterization of CO + H_2 catalysts for production of light hydrocarbons, 4:38315 (LBL-8975)
COPPER HYDRIDES/CRYSTAL STRUCTURE
Proton magnetic resonance studies of TiCuH, 4:39176
COPPER HYDRIDES/SPIN-LATTICE RELAXATION
Proton magnetic resonance studies of TiCuH, 4:39176
COPPER IONS/COLLISIONS
Impact-parameter dependence of K-vacancy production in Cu-Ni collisions, 4:39799
COPPER OXIDES/CHEMICAL ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
COPPER SELENIDES/COMPATIBILITY
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM-6660)
COPPER SULFIDES/CATHODE SPUTTERING
Formation of thin Cu_2S (chalcocite) films using reactive sputtering techniques, 4:38394
COPPER SULFIDES/DEPOSITION
Copper sulfide films deposited by cylindrical magnetron reactive sputtering, 4:39188
COPPER SULFIDES/EPITAXY
Formation of thin Cu_2S (chalcocite) films using reactive sputtering techniques, 4:38394
CORIUM/FREEZING
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
CORONA (SOLAR)
See SOLAR CORONA
CORROSION PRODUCTS/FILTRATION
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
CORROSION PRODUCTS/REMOVAL
Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits, 4:38628
COSMIC NEUTRINOS/ENERGY SPECTRA
Diffuse fluxes of cosmic high energy neutrinos, 4:39730 (N-78-31040)
COSMIC NEUTRINOS/FLUX DENSITY
Diffuse fluxes of cosmic high energy neutrinos, 4:39730 (N-78-31040)

COSMIC X-RAY SOURCES/X-RAY SPECTRA
Discovery of iron line emission in the Hercules X-1 low-state spectrum with HEAO-1, 4:39740 (N-78-31038)
High energy x-ray spectra of Cygnus XR-1 observed from OSO-8, 4:39742 (N-78-32017)
X-ray observations of BL Lac objects, 4:39741 (N-78-32016)
COSMOLOGICAL MODELS/BARYON NUMBER
Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
COSMOLOGICAL MODELS/MATTER
Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
COSMOS
See UNIVERSE
COST/COMPUTER CALCULATIONS
Description of data entry for automated cost estimating, 4:40035 (K/CSD/TM-29)
COST BENEFIT ANALYSIS/TECHNOLOGY ASSESSMENT
Very-low-head hydroelectric generation, 4:38338
COUNTERS (RADIATION)
See RADIATION DETECTORS
COUPLED FAST REACTOR MEASUREMENT FACILITY
See CFRMF REACTOR
COUPLINGS/PERFORMANCE TESTING
Flexible connectors, 4:38184 (CONF-7611113-)
CRBR REACTOR
See CLINCH RIVER BREEDER REACTOR
C-REACTIVE PROTEIN
See GLOBULINS
CREEKS
See RIVERS
CRESOLS/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
CRESYLIC ACID
See CRESOLS
CRITICALITY
Criticality calculations with various weighted difference equations, 4:38721 (INIS-mf-4052)
CRITICALITY ACCIDENTS
See RADIATION ACCIDENTS
CROPS/CONTAMINATION
Chalk point cooling tower project: cooling tower effects on crops and soils. preoperational report. Report for April 1973-April 1975, 4:38593 (PB-284075)
Chalk point cooling tower project: cooling tower effects on crops and soils. Preoperational report, appendix. Report for April 1973-April 1975, 4:38594 (PB-284076)
Chalk point cooling tower project: cooling tower effects on crops and soils. Postoperational report No. 1, Volume 1. Final report, May 1975-April 1976, 4:38595 (PB-284077)
Chalk point cooling tower project: cooling tower effects on crops and soils. postoperational report no. 1, volume 2. Final report May 1975-April 1976, 4:38596 (PB-284078)
Chalk point cooling tower project: cooling tower effects on crops and soils. post operational report no. 2. Final report FY 1977, 4:38597 (PB-284094)
CRUDE OIL
See PETROLEUM
CRYOGENICS/RESEARCH PROGRAMS
Cryogenics at the University, of Virginia. Final technical report, 4:39944 (AD-A-058269)
Low temperature physics and engineering. Quarterly progress report, July 1-September 30, 1978, 4:39813 (LA-7691-PR)
CRYOPUMPS/SPECIFICATIONS
Doublet III neutral beam source cryopanel system, 4:40019 (LBL-8900)
CRYSTAL GROWTH/MATHEMATICAL MODELS
Development of a model and computer code to describe solar grade silicon production processes. Fourth quarterly report, July 1-September 30, 1978, 4:38398 (DOE/JPL/954862-4)
CRYSTAL STRUCTURE/ANALYTICAL SOLUTION
Structure solution methods for superstructures, 4:39945 (CONF-790342-1)
CRYSTAL STRUCTURE/MEASURING METHODS
Structure solution methods for superstructures, 4:39945 (CONF-790342-1)
CRYSTALLINE LENS/BIOLOGICAL RADIATION EFFECTS
Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968-December 31, 1978J (X radiation), 4:39668 (COO-2012-38)
CRYSTALS
See also LIQUID CRYSTALS
CRYSTALS/CRACKS
Elastic energy of slit cracks in hexagonal crystals, 4:39130
CRYSTALS/ELASTICITY
Elastic energy of slit cracks in hexagonal crystals, 4:39130
CURIUM ISOTOPES/AVAILABILITY
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
CURIUM ISOTOPES/HEALTH HAZARDS
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
CUTTER LOADERS/ELECTRIC MOTORS
Mining machine (PAtent), 4:38108
CUTTING TOOLS/DESIGN
Tool for cutting insulation from electrical cables (Patent), 4:39266
CUTTING TOOLS/WEAR
Micro-isotope tool wear detector, phase I - Final report. Report for 1 October 1977-31 May 1978, 4:38305 (PB-284699)
CYANIDES/LEACHING
Investigation of the environmental consequences of disposal of the lithium organic-electrolyte/SO_2 battery. Final report Sep 76-Jan 78, 4:39596 (AD-A-059512)
CYCLIC ACCELERATORS
See also BEVALAC
LINEAR ACCELERATORS
CYCLIC ACCELERATORS/BEAM DYNAMICS
Stochastic cooling theory and devices, 4:39410 (LBL-7574)
CYCLIC ACCELERATORS/EFFICIENCY
Trirotron, 4:39462 (SLAC-PUB-2266)
CYCLIC ACCELERATORS/RF SYSTEMS
Advances in high-power rf amplifiers, 4:39452 (LA-UR-79-705)
CYCLIC ACCELERATORS/TRAVELLING WAVES
Trirotron, 4:39462 (SLAC-PUB-2266)
CYCLOALKANES/CATALYTIC CRACKING
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
CYCLOTRON INSTABILITY/BETA RATIO
Finite beta effects on the drift-cyclotron instability, 4:39993
CYLINDRICAL PARABOLIC COLLECTORS
See PARABOLIC TROUGH COLLECTORS
CYTOLOGICAL TECHNIQUES
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR-3490-1480)
CZOCHRALSKI METHOD/ECONOMIC ANALYSIS
Continuous Czochralski process development. LSSA large area silicon sheet task. Annual report, October 1977-September 1978, 4:38375 (DOE/JPL/954887-4)
CZOCHRALSKI METHOD/EQUIPMENT
Silicon sheet growth development of the large area silicon sheet task of the low cost silicon solar array project. Third quarterly progress report, April 1-June 30, 1978, 4:38376 (DOE/JPL/954888-3)
CZOCHRALSKI METHOD/MATHEMATICAL MODELS
Continuous Czochralski process development. LSSA large area silicon sheet task. Annual report, October 1977-September 1978, 4:38375 (DOE/JPL/954887-4)

D

D RESONANCES/HADRONIC PARTICLE DECAY
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
D RESONANCES/MASS SPECTRA
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
D RESONANCES/PARTICLE PROPERTIES
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
D RESONANCES/PARTICLE STRUCTURE
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
D RESONANCES/SEMILEPTONIC DECAY
Lecture IV. Experimental status of charm (Lectures, review), 4:39860 (FERMILAB-CONF-78/37-THY)
DARRIEUS ROTORS/AERODYNAMICS
User's manual for the compuer code PAREP, 4:38564 (SAND-79-0431)
DATA ANALYSIS/SET THEORY
Study of set-theoretic information processing, 4:38859 (UCRL-13970)
DATA PROCESSING/SET THEORY
Study of set-theoretic information processing, 4:38859 (UCRL-13970)

DATA PROCESSING/SYSTEMS ANALYSIS
Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP-9104(Add.3))
DATA STORAGE DEVICES
See MEMORY DEVICES
DATUM PRESSURE
See RESERVOIR PRESSURE
DECONTAMINATION/OPTIMIZATION
Optimization of decontamination strategy for CANDU-PHW reactors, 4:38659
DEEP INELASTIC SCATTERING/ANGULAR MOMENTUM
Angular momentum transfer in deep inelastic scattering. Experimental evidence and a model based upon particle transfer, 4:39933 (INIS-mf-4427)
DEEP INELASTIC SCATTERING/COLLECTIVE MODEL
Role of deep inelastic processes in nuclear physics: experimental and theoretical aspects of deep inelastic reactions (Mass asymmetry, diffusion, charge and angular distributions, energy and momentum transfer), 4:39834 (LBL-8936)
DEEP INELASTIC SCATTERING/QUASI-FISSION
Role of deep inelastic processes in nuclear physics: experimental and theoretical aspects of deep inelastic reactions (Mass asymmetry, diffusion, charge and angular distributions, energy and momentum transfer), 4:39834 (LBL-8936)
DEEP INELASTIC SCATTERING/RELAXATION
Role of deep inelastic processes in nuclear physics: experimental and theoretical aspects of deep inelastic reactions (Mass asymmetry, diffusion, charge and angular distributions, energy and momentum transfer), 4:39834 (LBL-8936)
DEER/DIET
Diets of mule deer within steppe vegetation of south central Washington (Dietary preferences at three locations on the Hanford Reservation), 4:39606 (BNWL-SA-6532)
DENSITOMETERS/PERFORMANCE
X-ray microdensitometer (XRPD) performance characteristics, 4:39498 (UCRL-52657)
DEOXYPENTOSE NUCLEIC ACID
See DNA
DEOXYRIBONUCLEIC ACID
See DNA
DEPARTMENT OF DEFENSE
See US DOD
DESALINATION REACTORS/COST
Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant, 4:38717 (ORNL/TM-6821)
DESALINATION REACTORS/COST BENEFIT ANALYSIS
Some considerations of operating nuclear powered dual purpose electricity/water installations, 4:38710 (IAEA-206)
DESALINATION REACTORS/ECONOMICS
Small nuclear reactors for desalination, 4:38709 (IAEA-206)
Summary report and recommendations, 4:38713 (IAEA-206)
DESALINATION REACTORS/MEETINGS
Heat utilization from nuclear reactors for desalting of sea water, 4:38712 (IAEA-206)
DESALINATION REACTORS/PLANNING
Desalination projects in the Kingdom of Saudi Arabia, 4:38707 (IAEA-206)
Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants, 4:38706 (IAEA-206)
Status of desalination projects in Iran, 4:38708 (IAEA-206)
DESALINATION REACTORS/SOCIO-ECONOMIC FACTORS
Status of desalination projects in Iran, 4:38708 (IAEA-206)
DESALINATION REACTORS/SPECIFICATIONS
Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant, 4:38717 (ORNL/TM-6821)
Summary report and recommendations, 4:38713 (IAEA-206)
DESERTS/ARTHROPODS
Distribution and abundance of soil arthropods in the northern Mojave desert, 4:39595 (UCLA-12-1190)
DESICCANTS/TECHNOLOGY ASSESSMENT
Natural gas dehydration with solid desiccant, 4:38176 (CONF-7611113-)
DESORPTION/CHEMICAL REACTION KINETICS
Desorption kinetics of one- and two-step mechanisms, 4:39232
DESORPTION/KINETICS
Heat of vaporization spectrometer, 4:39234
DESOXYRIBONUCLEIC ACID
See DNA
DETECTORS (RADIATION)
See RADIATION DETECTORS
DETONATION WAVES
See SHOCK WAVES
DETONATORS
M-3 Series on Detonation Science. II. One-dimensional flow, 4:39516 (LA-7817-MS(Vol.2))
DEUTERIUM/ADSORPTION
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
DEUTERIUM/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
DEUTERIUM/TRACER TECHNIQUES
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{3}H (Mice), 4:39692 (BNL-25910)
DEUTERIUM COMPOUNDS/CRYSTAL STRUCTURE
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341-3)
DEUTERIUM COMPOUNDS/CRYSTAL-PHASE TRANSFORMATIONS
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341-3)
DEUTERIUM COMPOUNDS/ROTATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
DEUTERIUM COMPOUNDS/THERMODYNAMIC PROPERTIES
Stability of the lanthanide hydrides, 4:39221 (LA-7602-MS)
DEUTERIUM COMPOUNDS/VIBRATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
DEUTERIUM IONS/COLLISIONS
Application of matrix isolation spectroscopy to the measurement of sputtering yields, 4:39098
H^{+} and D^{+} sputtering of thin tantalum films in the energy range of 0.6 to 15 keV, 4:39148
DEUTERIUM IONS/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
DEUTERIUM TARGET/ELECTRON REACTIONS
Parity non-conservation in inelastic electron scattering (Asymmetries), 4:39870
DEUTERON REACTIONS/BREAKUP REACTIONS
Absolute cross sections for three-body breakup reactions $^{6}Li(d,n\,^{3}He)^{4}He$ and $^{6}Li(d,p\,^{3}H)^{4}He$, 4:39894
DEUTERON REACTIONS/STRIPPING
Electric monopole transitions and excited 0^{+} states in ^{250}Cf, 4:39920
Excitation function for ^{15}O production via the ^{14}N (d,n)^{15}O reaction (cross sections, 0.6 to 14.35 MeV), 4:39898
DEVELOPED COUNTRIES/POLLUTION LAWS
NATO CCMS pilot study, disposal of hazardous wastes, phase 1. Final report, 4:39048 (PB-286050)
DEVELOPED COUNTRIES/POLLUTION REGULATIONS
NATO CCMS pilot study, disposal of hazardous wastes, phase 1. Final report, 4:39048 (PB-286050)
DEVELOPING COUNTRIES/ECONOMIC DEVELOPMENT
Science, technology, and development in a new social order, 4:38872
Understanding of the importance of Arab/Islamic funds available for development projects and economic support, 4:38871
DEVELOPING COUNTRIES/ENERGY ANALYSIS
Systems framework for energy analysis in developing countries, 4:38860 (BNL-25933)
DEVELOPING COUNTRIES/ENERGY POLICY
Systems framework for energy analysis in developing countries, 4:38860 (BNL-25933)
DIAL PAINTERS/RADIATION INJURIES
Dose-response relationships for female radium dial workers (^{226}Ra, ^{228}Ra), 4:39673 (ANL-78-65(Pt.2))
DIAL PAINTERS/SURVIVAL TIME
Survival times of women radium dial workers first exposed before 1930, 4:39674 (ANL-78-65(Pt.2))
DIAMOND DRILLING EQUIPMENT
See DRILLING EQUIPMENT
DIAPHRAGMS (THERMONUCLEAR DEVICE)
See LIMITERS
DIESEL ENGINES/PERFORMANCE
High sulfur fuel effects in a two-cycle high speed army diesel engine. Interim report Oct 76-May 78, 4:39072 (AD-A-059534)
DIESEL FUELS/SULFUR
High sulfur fuel effects in a two-cycle high speed army diesel engine. Interim report Oct 76-May 78, 4:39072 (AD-A-059534)

DIET/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL-78-65(Pt.2))
DIETHYLENETRIAMINEPENTAACETIC ACID
See DTPA
DIFFERENTIAL EQUATIONS
See also DIRAC EQUATION
SCHROEDINGER EQUATION
DIFFERENTIAL EQUATIONS/NUMERICAL SOLUTION
Lipschitz constants and robust ODE codes, 4:40042 (SAND-79-0458C)
Multirate ordinary differential equation intergrator, 4:40031 (COO-2383-0056)
Solution of non-linear differential equations by discrete least squares (PDE), 4:40045
DIGITAL CIRCUITS/PERFORMANCE TESTING
Controllability/observability analysis of digital circuits, 4:39339 (SAND-78-1859C)
DIMETHYLKETONE
See ACETONE
2-2-DIMETHYLPROPANE/PHOTOIONIZATION
Laser photodetachment of electrons from O_2p in nonpolar liquids), 4:39250
DIODE TUBES/NUMERICAL SOLUTION
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
DIODE TUBES/SERVICE LIFE
Operation of repetitively pulsed 300 kV, 20 kA electron beam diode, 4:39461 (SAND-79-0596C)
DIODE TUBES/SIMULATION
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
DIODE TUBES/TWO-DIMENSIONAL CALCULATIONS
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
DIRAC EQUATION/QUANTUM OPERATORS
Gaps in the essential spectra of Schroedinger and Dirac operators, 4:39963 (N-78-30886)
DIRECT CONTACT HEAT EXCHANGERS/DESIGN
Study and testing of direct contact heat exchangers for geothermal brines. Phase II, August 1976-June 1977, 4:38542 (ORO-4893-2)
DIRECT ENERGY CONVERTERS
See also FUEL CELLS
MHD GENERATORS
SOLAR CELLS
THERMIONIC CONVERTERS
THERMOELECTRIC GENERATORS
DIRECT ENERGY CONVERTERS/USES
Direct energy conversion devices and their potential naval applications. Final report 1 jul-15 oct 76, 4:38943 (AD-A-059384)
DISK MHD GENERATORS/OPERATION
Open-cycle disk generator studies, 4:38949 (CONF-781009-)
DISK MHD GENERATORS/RESEARCH PROGRAMS
Combustion gas disk generator studies, 4:38948 (CONF-781009-)
DISK MHD GENERATORS/SIZE
Open-cycle disk generator studies, 4:38949 (CONF-781009-)
DISULFIDES/GAS CHROMATOGRAPHY
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
DNA
(Deoxyribonucleic acid.)
DNA/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
DNA/BIOLOGICAL REPAIR
Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N'-nitro-N-nitrosoguanidine, 4:39642
DNA/CONFIGURATION INTERACTION
Does DNA have two structures in solution that coexist at equilibrium, 4:39637 (UR-3490-1569)
DNA/HYBRIDIZATION
Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast, 4:39659 (UR-3490-1568)
DNA/MODIFICATIONS
Prevention of G:C pairing in mouse DNA by complete blocking of guanine residues with glyoxal. Availability of cytosine, adenine and thymine for hydrogen bonding with added unmodified polynucleotides, 4:39646
DOGS/BLOOD CELLS
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
DOGS/BONE MARROW CELLS
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
DOGS/REPRODUCTION
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
DOMAIN STRUCTURE/CURIE POINT
Automated system for electrical field-polarization studies in ferroelectrics, 4:39178
DOMAIN STRUCTURE/DIELECTRIC PROPERTIES
Automated system for electrical field-polarization studies in ferroelectrics, 4:39178
DOMAIN STRUCTURE/FERROELECTRIC MATERIALS
Automated system for electrical field-polarization studies in ferroelectrics, 4:39178
DOMAIN STRUCTURE/POLARIZATION
Automated system for electrical field-polarization studies in ferroelectrics, 4:39178
DOPED MATERIALS/PHYSICAL RADIATION EFFECTS
New materials properties achievable by ion implantation doping and laser processing, 4:39196 (CONF-781121-22)
DOSEMETERS
See also THERMOLUMINESCENT DOSEMETERS
DOSEMETERS/CALIBRATION
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
DOSEMETERS/SENSITIVITY
Passive particle dosimetry. Final report, 17 November 1970-30 June 1977, 4:39493 (N-78-27965)
DOSEMETERS/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
DOSIMETRY
See also GAMMA DOSIMETRY
MICRODOSIMETRY
DOSIMETRY/BIOPHYSICS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
DOSIMETRY/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
DOUBLET REACTORS/CRYOPUMPS
Doublet III neutral beam source cryopanel system, 4:40019 (LBL-8900)
DOUGLAS POINT ONTARIO REACTOR/CORROSION PRODUCTS
Formation, composition and structure of corrosion products in CANDU nuclear power reactors, 4:38657
DOUGLAS POINT ONTARIO REACTOR/STEAM SYSTEMS
Formation, composition and structure of corrosion products in CANDU nuclear power reactors, 4:38657
DOUGLAS POINT POWER STATION
See DOUGLAS POINT ONTARIO REACTOR
DOUNREAY PROTOTYPE FAST REACTOR
See PFR REACTOR
DOW PUSHER 700
See POLYAMIDES
DREDGE SPOIL/ENVIRONMENTAL EFFECTS
Aquatic disposal field investigations, Ashtabula River disposal site, Ohio. Appendix C. Investigation of water-quality and sediment parameters. Final report December 1974-January 1977, 4:39537 (AD-A-057461)
DRESDEN-1 REACTOR
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
DRIFT INSTABILITY/BETA RATIO
Finite beta effects on the drift-cyclotron instability, 4:39993
DRIFT INSTABILITY/MAGNETIC FIELDS
Turbulent destabilization and saturation of the universal drift mode in a sheared magnetic field, 4:39995
DRIFT INSTABILITY/TURBULENCE
Turbulent destabilization and saturation of the universal drift mode in a sheared magnetic field, 4:39995
DRILLING EQUIPMENT/DESIGN
Raise drill inner yoke bridge (Patent), 4:39280
DRINKING WATER/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
DRYERS
See also CLOTHES DRYERS
SOLAR DRYERS

DRYERS/DESIGN
Apparatus and method for drying seed corn by burning cobs (Patent), 4:39037
DRYERS/WASTE HEAT UTILIZATION
Apparatus for hot gas heat transfer particularly for paper drying (Patent), 4:39042
DTPA
(Diethylenetriaminepentaacetic acid.)
DTPA/THERAPY
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
DUAL-PURPOSE POWER PLANTS/COST
Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant, 4:38717 (ORNL/TM-6821)
DUAL-PURPOSE POWER PLANTS/COST BENEFIT ANALYSIS
Some considerations of operating nuclear powered dual purpose electricity/water installations, 4:38710 (IAEA-206)
DUAL-PURPOSE POWER PLANTS/ECONOMICS
Small nuclear reactors for desalination, 4:38709 (IAEA-206)
DUAL-PURPOSE POWER PLANTS/LIFE-CYCLE COST
Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1, 4:38566 (AD-A-057405)
DUAL-PURPOSE POWER PLANTS/PLANNING
Desalination projects in the Kingdom of Saudi Arabia, 4:38707 (IAEA-206)
Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants, 4:38706 (IAEA-206)
Status of desalination projects in Iran, 4:38708 (IAEA-206)
DUAL-PURPOSE POWER PLANTS/SOCIO-ECONOMIC FACTORS
Status of desalination projects in Iran, 4:38708 (IAEA-206)
DUAL-PURPOSE POWER PLANTS/SPECIFICATIONS
Conceptual design and cost study for a dual-purpose nuclear-electric reverse osmosis seawater conversion plant, 4:38717 (ORNL/TM-6821)
DUST COLLECTORS
Removal of fine particulates from gases in fluidized beds, 4:39350
DYE LASERS/FLUORESCENCE
Self-absorption of molecular fluorescence, the design of equipment for measurement of fluorescence decay, and the decay times of some laser dyes), 4:39297
DYE LASERS/TUNING
Tunable laser system for the ultraviolet, visible, and infrared regions, 4:39294 (UCRL-52000-79-3)
Tuning of the emission frequency of a dye laser with a Bragg mirror in the form of a cholesteric liquid crystal, 4:39312
DYES
See also ACRIDINE ORANGE
RHODAMINES
DYES/EXCITED STATES
Time dependence of triplet-singlet excitation transfer from compact poly rA to bound dye at 77 k, 4:39243
DYNAMICS
See MECHANICS
DYNAMICS (BEAM)
See BEAM DYNAMICS

E

EARTH ATMOSPHERE
See also AIR
IONOSPHERE
MAGNETOSPHERE
STRATOSPHERE
SURFACE AIR
TROPOSPHERE
EARTH ATMOSPHERE/MOISTURE
The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report, 4:39522 (AD-A-059705)
EARTH ATMOSPHERE/TURBULENCE
Atmospheric turbulence and diffusion boundary layer transport model, 4:39528 (BNL-25026)
EARTH PENETRATORS/PRIMARY BATTERIES
Testing of a lithium battery for use in an earth penetrator, 4:38847 (SAND-78-1364)
EARTH PLANET/LONG WAVE RADIATION
Direct measurements of the polarization of terrestrial kilometric radiation from Voyagers 1 and 2, 4:39757 (N-78-30758)
EARTH-COVERED BUILDINGS/PASSIVE SOLAR COOLING SYSTEMS
Sunearth home, 4:38435 (CONF-780337-P2)
EARTH-COVERED BUILDINGS/PASSIVE SOLAR HEATING SYSTEMS
Sunearth home, 4:38435 (CONF-780337-P2)
EAST MESA GEOTHERMAL FIELD/RESOURCE POTENTIAL
Results of reservoir engineering tests, 1977, East Mesa, California, 4:38546 (LBL-7091)
EBR-2 REACTOR/FAILED ELEMENT DETECTION
Results of UO_2 diagnostic tests for run beyond cladding breach in EBR-II, 4:38661 (ANL-78-99)
EBR-2 REACTOR/FUEL CANS
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
EBR-2 REACTOR/FUEL ELEMENT FAILURE
Results of UO_2 diagnostic tests for run beyond cladding breach in EBR-II, 4:38661 (ANL-78-99)
ECCS
(Emergency core cooling system.)
ECCS/PERFORMANCE
Status report on ECC penetration scaling research (PWR), 4:38815 (NUREG/CR-0651)
ECCS/TEST FACILITIES
Development of in-vessel reflood instrumentation at ORNL (PWR), 4:38794 (CONF-790340-1)
ECOLOGICAL COMMUNITIES
See ECOSYSTEMS
ECONOMIC ANALYSIS
Descriptor analysis of economic systems (Using descriptor variable theory), 4:38870 (TID-29393)
ECONOMIC DEVELOPMENT
See also COMMERCIAL SECTOR
ECONOMIC DEVELOPMENT/TECHNOLOGY UTILIZATION
Science, technology, and development in a new social order, 4:38872
ECOSYSTEMS
See also AQUATIC ECOSYSTEMS
TERRESTRIAL ECOSYSTEMS
ECOSYSTEMS/DATA ANALYSIS
Environmental Resources Section, 4:40051 (ORNL-5508)
ECOSYSTEMS/MANAGEMENT
Physical management of coastal floodplains: guidelines for hazards and ecosystems management. Report on task 1, 4:39594 (PB-284164)
ECOSYSTEMS/MATHEMATICAL MODELS
Ecosystem Studies Program, 4:39615 (ORNL-5508)
ECOSYSTEMS/SYSTEMS ANALYSIS
Ecosystem Studies Program, 4:39615 (ORNL-5508)
EFFLUENTS (CHEMICAL)
See CHEMICAL EFFLUENTS
EGR SYSTEMS
See EXHAUST RECIRCULATION SYSTEMS
EHF RADIATION
See MICROWAVE RADIATION
EHV AC SYSTEMS/OPERATION
Optimum hydrothermal electric energy system scheduling: challenges and opportunities in research and development in Canada, 4:38572
EINSTEIN-DE SITTER MODEL
See COSMOLOGICAL MODELS
EL SALVADOR/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
ELDERLY PEOPLE/ENERGY CONSUMPTION
Los Angeles senior citizen lifeline electricity rates, 4:38932 (RAND/R-2278-DWP/NSF)
ELECTRIC BATTERIES
(Devices for production and/or storage of electrical energy from chemical reactions; excludes FUEL CELLS and RADIOISOTOPE BATTERIES.)
See also LEAD-ACID BATTERIES
ELECTRIC BATTERIES/BIBLIOGRAPHIES
Battery literature search, bibliography and abstracts. Volume II, 4:38841 (N-77-74766)
Battery literature search, bibliography and abstracts. Volume V, 4:38842 (N-77-74769)
ELECTRIC BATTERIES/DESIGN
Overchargeable sealed metal oxide/lanthanum nickel hydride battery (Patent), 4:38986
ELECTRIC BATTERIES/ELECTROCHEMISTRY
Electrochemical reactions at surfaces. Volume 1. 1964-1975 (a bibliography with abstracts). Report for 1964-75, 4:39247 (NTIS/PS-78/1033)

Electrochemical reactions at surfaces. volume 2. 1976-September, 1978 (a bibliography with abstracts). Report for 1976-September 1978, 4:39248 (NTIS/PS-78/1034)
ELECTRIC BATTERIES/MEETINGS
Summary transcript of IBMA annual convention, October 12-14, 1977 (Chicago, October 12-14, 1977), 4:38843
ELECTRIC BATTERIES/PERFORMANCE TESTING
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)
ELECTRIC BATTERIES/RESEARCH PROGRAMS
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)
ELECTRIC CABLES
See also SUPERCONDUCTING CABLES
ELECTRIC CABLES/ELECTRICAL INSULATION
Tool for cutting insulation from electrical cables (Patent), 4:39266
ELECTRIC CABLES/PERFORMANCE
Frequency distortions in a multistrand cable during electrical surveying of wells, 4:38136
ELECTRIC CABLES/PHYSICAL RADIATION EFFECTS
Radiation effects in satellite cables. Final report 1 Apr 77-31 Mar 78, 4:39502 (AD-A-059446)
ELECTRIC CONDUCTIVITY
See also SUPERCONDUCTIVITY
ELECTRIC CONDUCTIVITY/DIAGNOSTIC TECHNIQUES
Alternative methods for determining the electrical conductivity of core samples, 4:39709
ELECTRIC CONDUCTIVITY/GEOPHYSICS
Alternative methods for determining the electrical conductivity of core samples, 4:39709
ELECTRIC CONDUCTIVITY/MEASURING METHODS
Alternative methods for determining the electrical conductivity of core samples, 4:39709
ELECTRIC CONDUCTORS/FABRICATION
Method for preparing a thick film conductor (Patent), 4:39342
ELECTRIC CONDUCTORS/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
ELECTRIC CONTACTORS
See SWITCHES
ELECTRIC FIELDS/POTENTIAL ENERGY
Interpretation of the ponderomotive potential for a magnetized particle in a low-frequency wave, 4:40000
ELECTRIC GENERATORS
(Rotating generators only; excludes DIRECT ENERGY CONVERTERS.)
See also WATER CURRENT POWER GENERATORS
ELECTRIC GENERATORS/COMPUTER-AIDED DESIGN
Electric generator development for the 1980's. Final report July 1975-April 1978, 4:38581 (AD-A-057448)
ELECTRIC GENERATORS/PERFORMANCE TESTING
Electric generator development for the 1980's. Final report July 1975-April 1978, 4:38581 (AD-A-057448)
ELECTRIC MOTORS
See also SUPERCONDUCTING MOTORS
ELECTRIC MOTORS/CONTROL
Mining machine (PAtent), 4:38108
ELECTRIC MOTORS/ON-LINE CONTROL SYSTEMS
Stepping motor translator (Patent application), 4:39344
ELECTRIC POWER
See also EPRI
HYDROELECTRIC POWER
OFF-PEAK POWER
ELECTRIC POWER/CHARGES
Aspects of public utility regulation. Staff research report, 4:38920 (PB-284145)
ELECTRIC POWER/CONSUMPTION RATES
Demand management demonstration project. Stage 1: development of residential load characteristics and Stage 4: demonstration of residential incremental cost pricing implemented by time-of-day metering. Final report, January 1979, 4:38930 (HCP/B8072-01)
ELECTRIC POWER/PEAK-LOAD PRICING
Electric utility financial problems and potential solutions. Summary report, 4:38936 (PB-285827)
ELECTRIC POWER/RATE STRUCTURE
Demand management demonstration project. Stage 1: development of residential load characteristics and Stage 4: demonstration of residential incremental cost pricing implemented by time-of-day metering. Final report, January 1979, 4:38930 (HCP/B8072-01)
ELECTRIC POWER INDUSTRY/RESEARCH PROGRAMS
1979 Research Program, 4:38929 (EPRI-PS-952-SR)
ELECTRIC POWER RESEARCH INSTITUTE
See EPRI
ELECTRIC SWITCHES
See SWITCHES
ELECTRIC UTILITIES
See also FOSSIL-FUEL POWER PLANTS
See PUBLIC UTILITIES
ELECTRIC UTILITIES/ENERGY CONSERVATION
Office of Conservation third quarterly report, July-September 1978 (Seattle City Light), 4:38907
ELECTRIC UTILITIES/ENERGY STORAGE
Cost-allocation model for assessing the impact of energy-storage technologies upon electric utilities, 4:38897 (CONF-781213-6)
ELECTRIC UTILITIES/FINANCING
Electric utility financial problems and potential solutions. Summary report, 4:38936 (PB-285827)
ELECTRIC UTILITIES/FUEL CONSUMPTION
Short term coal demand model. Final report, 4:38127 (DOE/TIC-10089)
ELECTRIC UTILITIES/GAS TURBINES
Comparison of projected electric-utility peaking-gas-turbine energy requirements to potential alcohol fuels availability: 1980-2000, 4:38591 (HCP/M2098-02)
Gas-turbine electric plant construction cost and annual production expenses, 1976. Energy data report fourth annual supplement (520 plants), 4:38590 (DOE/EIA-0180)
ELECTRIC UTILITIES/LOAD MANAGEMENT
Electrical load management: the British experience. Part II (Nighttime demand at record highs), 4:38937
Office of Conservation third quarterly report, July-September 1978 (Seattle City Light), 4:38907
ELECTRIC UTILITIES/PEAKING POWER PLANTS
Comparison of projected electric-utility peaking-gas-turbine energy requirements to potential alcohol fuels availability: 1980-2000, 4:38591 (HCP/M2098-02)
ELECTRIC UTILITIES/RATE STRUCTURE
Los Angeles senior citizen lifeline electricity rates, 4:38932 (RAND/R-2278-DWP/NSF)
ELECTRIC UTILITIES/REGULATIONS
Role of a private utility in production of energy, 4:38934
ELECTRIC UTILITIES/RESEARCH PROGRAMS
1979 Research Program, 4:38929 (EPRI-PS-952-SR)
ELECTRICAL INSULATION/REMOVAL
Tool for cutting insulation from electrical cables (Patent), 4:39266
ELECTRICAL INSULATORS/BREAKDOWN
Experience with accelerating tubes, 4:39376 (LA-7445-C)
ELECTRICAL INSULATORS/MATERIALS
Materials, 4:39165
ELECTRICAL INSULATORS/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
ELECTRIC-POWERED VEHICLES/SODIUM-SULFUR BATTERIES
Electrochemical storage cell (Patent), 4:38851
ELECTROCHEMICAL CORROSION/RESEARCH PROGRAMS
Experimental application of design principles in corrosion research, 4:39183
ELECTROCHEMISTRY/BIBLIOGRAPHIES
Electrochemical reactions at surfaces. Volume 1. 1964-1975 (a bibliography with abstracts). Report for 1964-75, 4:39247 (NTIS/PS-78/1033)
Electrochemical reactions at surfaces. volume 2. 1976-September, 1978 (a bibliography with abstracts). Report for 1976-September 1978, 4:39248 (NTIS/PS-78/1034)
ELECTRODES
See also CATHODES
ELECTRODES/CORROSION
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
ELECTRODES/ELECTRIC DISCHARGES
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
ELECTRODES/MATERIALS
Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009-)
Materials, 4:39165
ELECTRODES/MATERIALS TESTING
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
ELECTRODES/PERFORMANCE
Construction and thermodynamic performance of an Ag-AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
ELECTROLYTES/SOLUBILITY
Investigation of the environmental consequences of disposal of the lithium organic-electrolyte/SO_2 battery. Final report Sep 76-Jan 78, 4:39596 (AD-A-059512)
ELECTROMAGNETIC FIELDS
See also ELECTROMAGNETIC PULSES

ELECTROMAGNETIC FIELDS/BIOLOGICAL EFFECTS
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
ELECTROMAGNETIC INTERACTIONS
See also PHOTON-PHOTON INTERACTIONS
ELECTROMAGNETIC INTERACTIONS/ANNIHILATION
Anomalous $e^+ e^-$ and $\mu^+ \mu^-$ events produced in $e^+ e^-$ annihilation (Differential cross sections), 4:39846
ELECTROMAGNETIC PULSES
H.E. EMP: The "HASH", 4:39520 (UCID-18165)
ELECTROMAGNETIC RADIATION
See also CHERENKOV RADIATION
GAMMA RADIATION
LASER RADIATION
MICROWAVE RADIATION
RADIOWAVE RADIATION
SYNCHROTRON RADIATION
X RADIATION
ELECTROMAGNETIC RADIATION/REFLECTION
Inversion of one-dimensional scattering data using Prony's method, 4:39962 (UCRL-52667)
ELECTROMAGNETIC SURVEYS/MEASURING INSTRUMENTS
Progress report, 4:39505 (IDO-1702-T1)
ELECTRON BEAM WELDING/AUTOMATION
Computer automation of an electron-beam welder, 4:39097 (Y/DA-8239)
ELECTRON BEAM WELDING/WELDING MACHINES
Computer automation of an electron-beam welder, 4:39097 (Y/DA-8239)
ELECTRON BEAMS/BEAM DYNAMICS
Energy recovery and power stabilization of pulsed electron beams in Marx generator circuits, 4:39393 (CONF-771035-P2)
Performance characteristics of large area electron accelerators, 4:39397 (CONF-771035-P2)
ELECTRON BEAMS/BEAM INJECTION
Limiting currents for injection of an unneutralized magnetized relativistic electron beam into a cylindrical drift tube, 4:39430 (CONF-771035-P2)
ELECTRON BEAMS/BEAM PRODUCTION
Microsecond intensive e-beams, 4:39392 (CONF-771035-P2)
ELECTRON BEAMS/BEAM TRANSPORT
High intensity electron beam propagation between two plane conductors and its implications for collective ion acceleration, 4:39379 (AD-A-059337)
REB focusing and transport investigations, 4:39396 (CONF-771035-P2)
ELECTRON BEAMS/COHERENT SCATTERING
Millimeter wave generation through stimulated scattering with an intense relativistic electron beam and a controlled zero-frequency pump, 4:39335 (CONF-771035-P2)
Zero frequency pumped stimulated Raman scattering by an intense relativistic electron beam, 4:39334 (CONF-771035-P2)
ELECTRON BEAMS/CURRENT DENSITY
Performance characteristics of large area electron accelerators, 4:39397 (CONF-771035-P2)
ELECTRON BEAMS/FIELD EMISSION
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
ELECTRON BEAMS/MASERS
Microwave generation and frequency conversion using intense relativistic electron beams, 4:39332 (CONF-771035-P2)
ELECTRON BEAMS/MEETINGS
High power electron and ion beam research and technology, 4:39439 (CONF-771035-P2)
ELECTRON BEAMS/MICROWAVE RADIATION
Microwave generation and frequency conversion using intense relativistic electron beams, 4:39332 (CONF-771035-P2)
Millimeter wave generation through stimulated scattering with an intense relativistic electron beam and a controlled zero-frequency pump, 4:39335 (CONF-771035-P2)
ELECTRON BEAMS/PULSE TECHNIQUES
Energy recovery and power stabilization of pulsed electron beams in Marx generator circuits, 4:39393 (CONF-771035-P2)
ELECTRON BEAMS/RELATIVISTIC RANGE
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
ELECTRON BEAMS/USES
Electron and ion beam science and technology, 4:39343
ELECTRON COOLING/EQUATIONS
Overview of beam cooling, 4:39409 (LBL-7574)
Relativistic electron cooling for high luminosity proton-anti proton colliding beams at very high energies, 4:39413 (LBL-7574)
ELECTRON CYCLOTRON MASERS
See MICROWAVE AMPLIFIERS
ELECTRON DIFFRACTION/DATA ACQUISITION
Chemical poisoning in heterogeneously catalyzed reactions, 4:39239 (LBL-8975)
ELECTRON GUNS/PERFORMANCE
High peak power pulsed WIP electron gun. Final report, 1 April-1 October 1978, 4:39773 (UCRL-13950)
ELECTRON REACTIONS/INELASTIC SCATTERING
Inelastic electron scattering in $_{28}$Si between 4 MeV and 50 MeV excitation energy. Master's thesis, 4:39899 (AD-A-057898)
Inelastic electron scattering from ^{14}N at 180°, 4:39890
Parity non-conservation in inelastic electron scattering (Asymmetries), 4:39870
ELECTRON SOURCES/CURRENT DENSITY
Performance characteristics of large area electron accelerators, 4:39397 (CONF-771035-P2)
ELECTRON-ATOM COLLISIONS/IONIZATION
Theoretical cross sections for ionization of metastable excimers Ne^*_2 and Ar^*_2 by electron impact, 4:39797
ELECTRON-DEUTERON INTERACTIONS/P INVARIANCE
Parity non-conservation in inelastic electron scattering (Asymmetries), 4:39870
Parity violation in inelastic scattering of polarized electrons (19.4 and 22.2 GeV, asymmetry, cross sections), 4:39815 (SLAC-PUB-2218)
ELECTRONIC DATA PROCESSING
See DATA PROCESSING
ELECTRONIC EQUIPMENT
See also POWER SUPPLIES
ELECTRONIC EQUIPMENT/PHYSICAL RADIATION EFFECTS
Radiation effects. Engineering handbook (methods of improving the radiation tolerance of electronics in space vehicles). Final report, 4:39503 (N-78-30544)
ELECTRONIC EQUIPMENT/RADIATION HARDENING
EMP, lightning, and power transients: their threat and relationship to future EMP standards. Technical note, 4:39501 (AD-A-058404)
Radiation effects. Engineering handbook (methods of improving the radiation tolerance of electronics in space vehicles). Final report, 4:39503 (N-78-30544)
ELECTRON-MOLECULE COLLISIONS/ELECTRON CAPTURE
Negative ions of polyatomic molecules (Resonance, anions, electron dissociative attachment, electron capture, potential energy, cross sections, yields, lifetime), 4:39783 (CONF-790344-1)
ELECTRON-POSITRON INTERACTIONS/ANNIHILATION
Charmed-baryon production in electron-positron annihilation, 4:39844
Multilepton final states and the weak interactions of the fifth quark, 4:39850
ELECTRON-POSITRON INTERACTIONS/DIFFERENTIAL CROSS SECTIONS
Production of jets and single particles at large transverse momentum in photon-photon collisions, 4:39842
ELECTRON-PROTON INTERACTIONS/P INVARIANCE
Parity non-conservation in inelastic electron scattering (Asymmetries), 4:39870
ELECTRON-RING ACCELERATORS/BEAM DYNAMICS
Beam trapping experiments on the University of Maryland Electron Ring Accelerator, 4:39389 (CONF-771035-P2)
Energy recovery and power stabilization of pulsed electron beams in Marx generator circuits, 4:39393 (CONF-771035-P2)
ELECTRON-RING ACCELERATORS/CATHODES
Properties of cathode plasma in the diode with magnetic insulation, 4:39394 (CONF-771035-P2)
ELECTRON-RING ACCELERATORS/FOCUSING
Study of 200KA REB focussing depending on the Kalmar diode geometry, 4:39395 (CONF-771035-P2)
Transverse stability in an electron ring accelerator, 4:39386 (CONF-771035-P2)
ELECTRON-RING ACCELERATORS/INSTABILITY
Transverse stability in an electron ring accelerator, 4:39386 (CONF-771035-P2)
ELECTRON-RING ACCELERATORS/MAGNETIC INSULATION
Properties of cathode plasma in the diode with magnetic insulation, 4:39394 (CONF-771035-P2)
ELECTRON-RING ACCELERATORS/POWER DENSITY
Study of 200KA REB focussing depending on the Kalmar diode geometry, 4:39395 (CONF-771035-P2)
ELECTRONS/DESORPTION
Ion and electron desorption of neutral molecules from stainless steel (304), 4:40025
ELECTRONS/ELECTRODYNAMICS
Radiation reaction in nonrelativistic quantum theory (Review), 4:39841 (LA-UR-79-357)

ELECTRONS/ENERGY CONSERVATION
Theory of electron energy confinement in tokamaks, 4:39968
ELECTRONS/ENERGY LOSSES
Inverse mean free path, stopping power, csda range, and straggling in polystyrene for electrons of energy < or = 10 keV. Interim technical report, 4:39939 (AD-A-057881)
ELECTRONS/EQUATIONS OF MOTION
Radiation reaction in nonrelativistic quantum theory (Review), 4:39841 (LA-UR-79-357)
ELECTRONS/FINE STRUCTURE
Radiation reaction in nonrelativistic quantum theory (Review), 4:39841 (LA-UR-79-357)
ELECTRONS/MEAN FREE PATH
Inverse mean free path, stopping power, csda range, and straggling in polystyrene for electrons of energy < or = 10 keV. Interim technical report, 4:39939 (AD-A-057881)
ELECTRONS/SELF-ENERGY
Radiation reaction in nonrelativistic quantum theory (Review), 4:39841 (LA-UR-79-357)
ELECTRONS/VACUUM POLARIZATION
Corrections to the sixth-order anomalous magnetic moment of the muon, 4:39845
ELECTROSTATIC ACCELERATORS
See also VAN DE GRAAFF ACCELERATORS
ELECTROSTATIC ACCELERATORS/MEETINGS
SNEAP: Symposium of North-Eastern Accelerator Personnel, 4:39359 (LA-7445-C)
ELECTROSTATIC LENSES/DESIGN
Strong focus electrostatic lens, 4:39464
ELECTROSTATIC LENSES/PERFORMANCE
Progress in space charge lens development, 4:39423 (UCRL-81834)
ELECTROSTATIC PRECIPITATORS/PERFORMANCE
Rapping reentrainment in a near full scale pilot electrostatic precipitator. Final report May 1975-April 1978, 4:38603 (PB-284452)
EMBRYONIC CELLS/BIOLOGICAL RADIATION EFFECTS
Suppression of transformed foci, induced by alpha radiation of C3H 10T1/2 cells, by untransformed cells, 4:39685 (ANL-78-65(Pt.2))
EMBRYONIC CELLS/CARCINOGENESIS
Transformations of C3H 10T1/2 cells by Benzo(a)pyrene and subsequent attempts at suppression of transformed foci by untransformed cells and Vitamin A (Alpha particles), 4:39686 (ANL-78-65(Pt.2))
EMERGENCY CORE COOLING SYSTEM
See ECCS
EMP
See ELECTROMAGNETIC PULSES
ENERGY
See also GEOTHERMAL ENERGY
NUCLEAR ENERGY
SOLAR ENERGY
ENERGY/BIBLIOGRAPHIES
Energy: A continuing bibliography with indexes, Issue 17, 4:40028 (N-78-31530)
ENERGY/COORDINATED RESEARCH PROGRAMS
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB-284375)
ENERGY/MEETINGS
Space and energy (XXVI international astronautical), 4:38354
ENERGY/RESEARCH PROGRAMS
Annotated bibliography of Interagency Energy/Environment R and D Program publications (Publications sponsored by USEPA), 4:39527 (PB-284399)
ENERGY ANALYSIS/EVALUATION
Systems framework for energy analysis in developing countries, 4:38860 (BNL-25933)
ENERGY CONSERVATION/DECISION MAKING
An energy conservation retrofit process for existing public and institutional facilities, 4:39011 (PB-284067)
ENERGY CONSERVATION/ECONOMICS
Energy saved is cheaper than energy generated, 4:38905
ENERGY CONSERVATION/EDUCATION
Energy conservation technology education program. Final report, 4:38902 (HCP/M-2165)
ENERGY CONSERVATION/ENERGY POLICY
Possibilities and limits of energy conservation in the Federal Republic, 4:38898
ENERGY CONSERVATION/FINANCIAL INCENTIVES
Energy managers focus on 1979 conservation plans, 4:38906
ENERGY CONSERVATION/GOVERNMENT POLICIES
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
ENERGY CONSERVATION/INFORMATION
Department of Energy workshop on industrial energy conservation reporting, Washington, DC, November 6-7, 1978, 4:39029 (RLO-1830-T1)
Office of Conservation third quarterly report, July-September 1978 (Seattle City Light), 4:38907
ENERGY CONSERVATION/PLANNING
Energy conservation plan for the state of Louisiana. (Public Law 94-163 and 94-385), 4:39050 (PB-284198)
University of Wyoming Energy Symposium, 4:38904 (PB-285510)
ENERGY CONSERVATION/PUBLIC OPINION
Energy conservation technology education program. Final report, 4:38902 (HCP/M-2165)
ENERGY CONSERVATION/REGULATIONS
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
ENERGY CONSERVATION/RESEARCH PROGRAMS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
Reference data: a basic plan for research and development, 4:38509
ENERGY CONSUMPTION/MANUALS
JPL energy consumption program (ECP) documentation: a computer model simulating, heating, cooling and energy loads in buildings, 4:38996 (N-78-31541)
ENERGY CONVERSION/COORDINATED RESEARCH PROGRAMS
Who's Who III in the Interagency Energy/Environment R and D Program (Directory of EPA sponsored projects), 4:38892 (PB-284228)
ENERGY DEMAND/FORECASTING
Short term coal demand model. Final report, 4:38127 (DOE/TIC-10089)
ENERGY FACILITIES/ENVIRONMENTAL IMPACTS
Heat releases of power plants, 4:39592
Meteorological aspects of energy use, 4:39534
Power production and its potential influence on the global climate, 4:39593
ENERGY FACILITIES/SEISMIC EFFECTS
Simplified design methods for nonlinear dynamic mechanical systems, 4:39958 (CONF-790608-1)
ENERGY MANAGEMENT
Energy managers focus on 1979 conservation plans, 4:38906
ENERGY MANAGEMENT/GOVERNMENT POLICIES
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
ENERGY MANAGEMENT/INFORMATION SYSTEMS
Energy Emergency Management Information System (EEMIS): program plan, 4:38910 (DOE/EIA-0135)
ENERGY MANAGEMENT/MEETINGS
Buildings energy management program workshop design. Final report, 4:39012 (CONS-8630-T1)
ENERGY MANAGEMENT/PLANNING
Energy Emergency Management Information System (EEMIS): program plan, 4:38910 (DOE/EIA-0135)
ENERGY MANAGEMENT/REGULATIONS
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
ENERGY MODELS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
ENERGY MODELS/ENERGY POLICY
Energy policy and mathematics, 4:38917 (ORAU/IEA-79-5(0))
ENERGY MODELS/OPERATION
Large-scale energy planning models: a methodological analysis. Final report, 4:38863 (PB-285642)
ENERGY OPERATORS
See HAMILTONIANS
ENERGY POLICY
See also NATIONAL ENERGY PLAN
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
Energy policy and mathematics, 4:38917 (ORAU/IEA-79-5(0))
The Presidential energy initiatives: Some relevant policy considerations, 4:38918 (PB-283971)
ENERGY POLICY/AGRICULTURE
Energy policies: Price impacts on the U.S. food system. Final agricultural economic report, 4:38868 (PB-285869)

ENERGY POLICY/MANAGEMENT
Resources, residuals and irreversible land conversions: prototype management instruments, 4:38877 (PB-283968)
ENERGY POLICY AND CONSERVATION ACT/ REGULATIONS
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/ TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
ENERGY SOURCE DEVELOPMENT/BUDGETS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
ENERGY SOURCE DEVELOPMENT/CHEMICAL EFFLUENTS
The development of a regional air pollution model and its application to the Northern Great Plains. Final report, 4:39568 (PB-285980)
ENERGY SOURCE DEVELOPMENT/ECONOMIC IMPACT
Attracting OCS related onshore facilities and activities: an assessment of prospects for New York state and their economic benefits, 4:38866 (PB-285197)
Marine related activities: an assessment of the economic impacts of OCS energy development, 4:38867 (PB-285198)
ENERGY SOURCE DEVELOPMENT/FEDERAL ASSISTANCE PROGRAMS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
ENERGY SOURCE DEVELOPMENT/FINANCIAL INCENTIVES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
ENERGY SOURCE DEVELOPMENT/NUMERICAL ANALYSIS
Environmental Resources Section, 4:40051 (ORNL-5508)
ENERGY SOURCE DEVELOPMENT/RESEARCH PROGRAMS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
ENERGY SOURCE DEVELOPMENT/SOCIAL IMPACT
Marine related activities: an assessment of the economic impacts of OCS energy development, 4:38867 (PB-285198)
ENERGY SOURCE DEVELOPMENT/SYSTEMS ANALYSIS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
ENERGY SOURCE DEVELOPMENT/WATER RESOURCES
Water related constraints in energy production. Final report, 4:38879 (PB-285713)
ENERGY SOURCES
See also FOSSIL FUELS
NUCLEAR FUELS
RENEWABLE ENERGY SOURCES
TIDAL POWER
WIND POWER
ENERGY SOURCES/ENVIRONMENTAL IMPACTS
Energy supply and environmental impacts conventional sources, study module III-A. Technical Appendix. Code users manual (final), 4:39634 (PB-283787)
ENERGY SOURCES/RESEARCH PROGRAMS
Reference data: a basic plan for research and development, 4:38509
ENERGY STORAGE
See also HEAT STORAGE
MAGNETIC ENERGY STORAGE EQUIPMENT
OFF-PEAK ENERGY STORAGE
ENERGY STORAGE/ECONOMIC IMPACT
Cost-allocation model for assessing the impact of energy-storage technologies upon electric utilities, 4:38897 (CONF-781213-6)
ENERGY STORAGE/RESEARCH PROGRAMS
Thermal and mechanical energy storage program, FY 1979: project summary data, 4:38830 (DOE/ET-0091)
ENERGY SUPPLIES/EMERGENCY PLAN
Energy Emergency Management Information System (EEMIS): program plan, 4:38910 (DOE/EIA-0135)
ENERGY SUPPLIES/ENERGY POLICY
Energy policy prospects as viewed by the Federal Government, 4:38924
ENGLAND
See UNITED KINGDOM
ENHANCED RECOVERY/DEMONSTRATION PROGRAMS
Contracts and grants for coopeative research on enhanced oil and gas recovery and improved drilling methods. Progress review No. 17, quarter ending December 31, 1978, 4:38137 (BETC-79/ 1)
ENHANCED RECOVERY/POLYMERS
Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977-September 1978, 4:39235 (BETC-5603-5)
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978-December 31, 1979, 4:39236 (BETC-5603-6)
ENHANCED RECOVERY/RESEARCH PROGRAMS
Contracts and grants for coopeative research on enhanced oil and gas recovery and improved drilling methods. Progress review No. 17, quarter ending December 31, 1978, 4:38137 (BETC-79/ 1)
Enhanced gas recovery program. Third annual report, October 1977-September 1978, 4:38180 (SAND-79-0056)
ENTOMOLOGY
See INSECTS
ENTRAINMENT/BIOLOGICAL EFFECTS
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
Comparison of residual biotoxicity of chlorine and bromine chloride to copepods. Technical report, 4:39695 (PB-286113)
ENTRAINMENT/ENVIRONMENTAL EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)
ENTRAINMENT/MATHEMATICAL MODELS
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
ENVIRONMENT/COORDINATED RESEARCH PROGRAMS
Who's Who III in the Interagency Energy/Environment R and D Program (Directory of EPA sponsored projects), 4:38892 (PB-284228)
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB-284375)
ENVIRONMENT/DATA BASE MANAGEMENT
Environmental data: management and needs analysis considerations, 4:40050 (CONF-790146-1)
ENVIRONMENT/RADIATION MONITORING
USERDA effluent data collection and reporting program, 4:39583
ENVIRONMENT/RADIOACTIVITY
USERDA effluent data collection and reporting program, 4:39583
ENVIRONMENT/RESEARCH PROGRAMS
Annotated bibliography of Interagency Energy/Environment R and D Program publications (Publications sponsored by USEPA), 4:39527 (PB-284399)
ENVIRONMENTAL EFFECTS/EVALUATION
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO-2874-46)
ENVIRONMENTAL EFFECTS/MEASURING METHODS
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO-2874-46)
ENVIRONMENTAL EXPOSURE CHAMBERS
See EXPOSURE CHAMBERS
ENVIRONMENTAL IMPACTS/INFORMATION SYSTEMS
Computer-aided analysis of coal gasification pilot plant data bases, 4:38060 (FE-2496-26)
ENVIRONMENTAL MATERIALS/CHEMICAL ANALYSIS
Environmental radioactivity laboratory intercomparison studies program, 1978-1979. Interim report, 4:39209 (PB-284850)
ENVIRONMENTAL POLICY/ECONOMIC IMPACT
Environmental pollution and energy: an economic evaluation, 4:38874
ENVIRONMENTAL TEMPERATURE
See AMBIENT TEMPERATURE
ENVIRONMENTAL TRANSPORT
See also ENVIRONMENT
RADIONUCLIDE MIGRATION
ENVIRONMENTAL TRANSPORT/MATHEMATICAL MODELS
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
MAP3S programs applicable to PEPE's (PEPE = Persistent Elevated Pollution Episode; MAP3S = Multi-State Atmospheric Power Production Pollution Study), 4:39573 (UCRL-82549)
ENZYMES
See also ESTERASES
NUCLEASES
POLYMERASES
ENZYMES/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
EPCA
See ENERGY POLICY AND CONSERVATION ACT
EPIPHYSIS (BONES)
See BONE TISSUES

EPITHELIUM/HISTOLOGY
Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL-78-65(Pt.2))
EPOXIDES/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
EPOXIDES/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
EPOXY COMPOUNDS
See EPOXIDES
EPRI
See also ELECTRIC POWER
EPRI/RESEARCH PROGRAMS
1979 Research Program, 4:38929 (EPRI-PS-952-SR)
EQUATIONS (DIFFERENTIAL)
See DIFFERENTIAL EQUATIONS
EQUILIBRIUM PLASMA/ROTATION
Astron type equilibrium in the absence of an applied magnetic field, 4:39984
EQUIPMENT PROTECTION DEVICES
See also CIRCUIT BREAKERS
EQUIPMENT PROTECTION DEVICES/SUPERCONDUCTING MAGNETS
Method and device for monitoring superconducting system (Patent), 4:39273
ERBIUM 154/MULTIPOLE TRANSITIONS
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912
ERBIUM 154/YRAST STATES
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912
ERBIUM 166 TARGET/TRITON REACTIONS
Levels in ^{165}Ho populated in the ^{166}Er(t(pol),α) reaction (Polarization, 17 MeV, analyzing powers, j, Nilson-model assignments), 4:39913
ERBIUM HYDRIDES/FABRICATION
Effects of vacuum processing erbium dideuteride/ditritide films deposited on chromium underlays on copper substrates, 4:39172
ERYTHROBLASTS
See BONE MARROW CELLS
ERYTHROCYTES/ATP
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR-3490-1480)
ERYTHROPOIETIN/BIOCHEMICAL REACTION KINETICS
Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
ERYTHROPOIETIN/BIOLOGICAL EFFECTS
Competition between erythropoietin and colony-stimulating factor for target cells in mouse marrow, 4:39640
ESCHERICHIA COLI/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
ESCHERICHIA COLI/BIOCHEMISTRY
Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N′-nitro-N-nitrosoguanidine, 4:39642
ESTERASES/CHEMICAL REACTIONS
Qualitative alterations in plasma esterases in BALB/c mice following the administration of diethylnitrosamine, 4:39648
ESTUARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
ETA-958 RESONANCES/HADRONIC PARTICLE DECAY
Resolution of the eta′ → eta $\pi\pi$ puzzle (Current algebra, symmetry breaking, qurk mass terms), 4:39858 (DOE/ER/70004-218)
ETA-958 RESONANCES/PARTICLE WIDTHS
Resolution of the eta′ → eta $\pi\pi$ puzzle (Current algebra, symmetry breaking, qurk mass terms), 4:39858 (DOE/ER/70004-218)
1,2-ETHANEDIAL
See GLYOXAL
ETHANOL/CONVERSION
Influence of f-electron configuration on catalytic properties of lanthanide oxides, 4:39242 (LBL-8975)
ETHANOL/PERFORMANCE TESTING
Ethanol/gasoline blends as automotive fuel, 4:39089 (BETC/RI-79/2)
ETHERS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
ETHERS/SEPARATION PROCESSES
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
ETHYLENE/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
ETHYLENE/COMBUSTION PRODUCTS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
ETHYLENE/ELECTRON COLLISIONS
Electron impact spectra of some mono-olefinic hydrocarbonsa), 4:39775
ETHYLENE/PRODUCTION
Processing of lignite for petrochemicals (Patent), 4:38069
ETHYLENE POLYMERS
See POLYETHYLENES
EUCALYPTUSES/CULTIVATION
Eucalyptus Energy Farms as a renewable source of fuel, 4:38401
EUCALYPTUSES/SCREENING
Eucalyptus Energy Farms as a renewable source of fuel, 4:38401
EUROPE
See also GERMAN FEDERAL REPUBLIC
ICELAND
ITALY
POLAND
UNITED KINGDOM
USSR
EUROPE/HEAT FLOW
The map of heat flow in Europe and its role in the preliminary evaluation of the sources of geothermal energy, 4:38521
EUROPEAN COMMUNITIES/ENERGY SOURCE DEVELOPMENT
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
EUROPIUM OXIDES/PHYSICAL RADIATION EFFECTS
BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME-78-103)
EVACUATED COLLECTORS/PERFORMANCE TESTING
Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND-78-0982)
EVACUATED COLLECTORS/TEST FACILITIES
Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND-78-0982)
EVAPORATION MODEL/FRAGMENTATION
Abrasion-ablation calculations of large fragment yields from relativistic heavy ion reactions, 4:39935
EWA REACTOR/REACTOR NOISE
Some recent developments in reactor noise analysis at Swierk, 4:38638
EXHAUST RECIRCULATION SYSTEMS/DESIGN
Engine exhaust gas recirculation system with periodic recalibration of exhaust back pressure reference (Patent), 4:39084
Exhaust gas recirculation apparatus for an internal combustion engine (Patent), 4:39055
Exhaust gas purification system (Patent), 4:39083
Exhaust gas recirculation system (Patent), 4:39085
EXPERIMENTAL BREEDER REACTOR-2
See EBR-2 REACTOR
EXPLORATORY WELLS/EVALUATION
Evaluation of Coso Geothermal Exploratory Hole No. 1 (CGEH-1) Coso Hot Springs: KGRA, China Lake, CA, 4:38526 (LBL-8675)
EXPLOSIONS
See also CHEMICAL EXPLOSIONS
NUCLEAR EXPLOSIONS
EXPLOSIONS/SEISMIC DETECTION
Relationship between near-field and teleseismic observations of seismic source parameters. Final report 1 Apr 73-30 Sep 77, 4:39526 (AD-A-059529)
EXPLOSIVE FRACTURING/MATHEMATICAL MODELS
Calculation of explosive rock breakage: oil shale, 4:38188 (LA-UR-79-646)
EXPLOSIVE FRACTURING/STRESS ANALYSIS
Techniques and problems relating to in situ measurment of stress waves in rubblization experiments, 4:38189 (SAND-78-2268C)
EXPOSURE CHAMBERS/AEROSOL MONITORING
Microprocessor-controlled inhalation system for repeated exposure of animals to aerosols, 4:39599
EXTRACTION APPARATUSES/MASS TRANSFER
Mass transfer in two-phase nondispersing liquid-liquid contactors with a high-density-difference system, 4:39215 (ORNL/TM-6670)
EXTRAPOLATION/ITERATIVE METHODS
Extrapolation of asymptotic expansions by a modified Aitken $\delta 2$-formula, 4:40043 (SU-326-P30-61)

EXXON GASIFICATION PROCESS/CATALYSTS
Exxon catalytic coal gasification process: predevelopment program. Annual report, July 1976-June 1977, 4:38058 (FE-2369-20)
EXXON GASIFICATION PROCESS/PILOT PLANTS
Exxon catalytic coal gasification process: predevelopment program. Annual report, July 1976-June 1977, 4:38058 (FE-2369-20)
EXXON LIQUEFACTION PROCESS
See also COAL LIQUEFACTION
EXXON LIQUEFACTION PROCESS/PILOT PLANTS
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)
EXXON LIQUEFACTION PROCESS/RESEARCH PROGRAMS
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)
EYES
See also CONJUNCTIVA
CRYSTALLINE LENS
RETINA
EYES/BIOCHEMISTRY
Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968-December 31, 1978J (X radiation), 4:39668 (COO-2012-38)
EYES/BIOLOGICAL RADIATION EFFECTS
Biochemical studies on the ocular lens in relation to cataractogenesis. Final report, July 1, 1968-December 31, 1978J (X radiation), 4:39668 (COO-2012-38)
EYES/RADIATION INJURIES
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL-78-65(Pt.2))

F

FABRY-PEROT INTERFEROMETER/NONLINEAR PROBLEMS
Theoretical and experimental study of the dynamic behavior of a nonlinear Fabry-Perot interferrometer, 4:39513
FALLOUT
(For radioactive fallout only.)
FALLOUT/WASHOUT
Introduction to self-induced rainout, 4:39582 (UCRL-52669)
FARADAY GENERATORS
See MHD GENERATORS
FARM EQUIPMENT/ENERGY CONSERVATION
Energy-saving milk production. Using the heat of the milk for heating water, 4:39032
FARMS/ENERGY SOURCES
Operation of an anaerobic digester at the Washington State Dairy Farm, 4:38321
FARMS/WASHINGTON
Operation of an anaerobic digester at the Washington State Dairy Farm, 4:38321
FAST FLUX TEST FACILITY REACTOR
See FFTF REACTOR
FAST REACTORS
See also CFRMF REACTOR
FFTF REACTOR
GCFR TYPE REACTORS
LMFBR TYPE REACTORS
FAST REACTORS/NEUTRON ABSORBERS
BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME-78-103)
FASTENERS/DESIGN
Dowel pin (Patent), 4:39264
FDR REACTOR
See OTTO HAHN REACTOR
FEDERAL BUILDINGS/ENERGY CONSERVATION
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
FEDERAL BUILDINGS/ENERGY MANAGEMENT
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
FEDERAL REPUBLIC OF GERMANY
See GERMAN FEDERAL REPUBLIC
FEED MATERIALS PLANTS/PLANNING
Uranium mining and milling. The need, the processes, the impacts, the choices. Administrator's guide. Final report, 4:38223 (PB-286034)
FEED MATERIALS PLANTS/RADIATION MONITORING
Miscellaneous data and information collected during radiation surveys at the former Monument Uranium Mill site (1974-1975). Technical note, 4:38287 (PB-285938)
FEEDWATER/RECYCLING
Water recycle/reuse alternatives in coal-fired steam-electric power plants. Volume II. Appendixes. Final report June 1975-February 1978, 4:38571 (PB-284676)
FERMILAB ACCELERATOR/ANTIPROTON BEAMS
Accommodating stochastic cooling at Fermilab, 4:39416 (LBL-7574)
FERMILAB ACCELERATOR/BEAM DYNAMICS
Collecting anti protons in the Fermilab Booster and very high energy proton-anti proton interactions. Appendix C, 4:39422 (LBL-7574)
FERMILAB ACCELERATOR/BEAM INJECTION
Antiproton momentum compactor-debuncher linac, 4:39420 (LBL-7574)
FERMILAB ACCELERATOR/COLLIDING BEAMS
Collecting anti protons in the Fermilab Booster and very high energy proton-anti proton interactions. Appendix C, 4:39422 (LBL-7574)
Colliding beams at Fermilab, 4:39476 (LBL-7574)
FERMILAB ACCELERATOR/ELECTRON COOLING
High-energy electron cooling, 4:39421 (LBL-7574)
FERRATES
See IRON OXIDES
FERRITES/LAYERS
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
FERTILIZER INDUSTRY/CHEMICAL EFFLUENTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
FERTILIZERS/BIOLOGICAL EFFECTS
Comparison of sludge and fertilizer applications on establishment and growth of seedlings of two sweetgum ecotypes endomycorrhizal with Glomus mosseae and G. etunicatus. Establishment and progress report, 4:39658 (SRO-0870-5)
FETUSES/PATHOLOGICAL CHANGES
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
FFTF REACTOR/AUXILIARY SYSTEMS
Distribution of revisions to FFTF FSAR, 4:38700 (HEDL-TI-75002-33)
FFTF REACTOR/ENVIRONMENTAL IMPACTS
FSAR Amendment 34: environmental technical specifications for the Fast Flux Test Facility (Chapter 18), 4:38701 (HEDL-TI-75002-34)
FFTF REACTOR/REACTOR COMPONENTS
Sodium technology progress report, October-December 1978, 4:38673 (HEDL-TME-78-93)
FFTF REACTOR/REACTOR PROTECTION SYSTEMS
Distribution of revisions to FFTF FSAR, 4:38700 (HEDL-TI-75002-33)
FFTF REACTOR/REACTOR START-UP
Status of FFTF startup program and future FFTF utilization, 4:38778 (HEDL-SA-1671)
FIBERS/ELECTROCHEMICAL CORROSION
Experimental application of design principles in corrosion research, 4:39183
FIBRINOGEN/BIOCHEMICAL REACTION KINETICS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
FIELD EFFECT TRANSISTORS/PERFORMANCE
Extension of high temperature electronics, 4:39340 (SAND-79-0388C)
FILMS
(Not for PHOTOGRAPHIC FILMS or NUCLEAR EMULSIONS.)

FILMS/FABRICATION
Large-area boron and carbon scatterers and filters, 4:39187 (UCID-18077)
FILMS/LIGHT TRANSMISSION
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
FILMS/MASS
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
FILMS/REFLECTIVITY
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
FILTERS
High flow, high temperature magnetic filtration of the primary heat transport coolant of the CANDU power reactors, 4:38653
FILTERS/PERFORMANCE
Graphite beds for coolant filtration at high temperature, 4:38648
Model for coal fly ash filtration, 4:39550
FIRE EXTINGUISHERS
Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL-82181)
FIREBALL MODEL/FRAGMENTATION
Abrasion-ablation calculations of large fragment yields from relativistic heavy ion reactions, 4:39935
FIREDAMP
See METHANE
FIREPLACES/DESIGN
Fireplace systems (Patent), 4:39006
FIRST WALL/DESIGN
Tokamak reactors and structural materials, 4:40007 (UWFDM-288)
FIRST WALL/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
Sputtering calculations with the discrete-ordinates method, 4:39781
FISH CULTURE
See AQUACULTURE
FISHES/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
FISHES/MORTALITY
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
FISHES/POPULATION DYNAMICS
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
FISSILE MATERIALS
(Materials containing nuclides capable of undergoing fission by interaction with slow neutrons.)
FISSILE MATERIALS/CALORIMETRY
Calorimetric assay of HTGR fuel samples, 4:38226 (ORNL/TM-6665)
FISSILE MATERIALS/PACKAGING
Standard format and content of Part 71 applications for approval of packaging of Type B, large quantity, and fissile radioactive material, 4:39278 (REG/G-7.9)
FISSILE MATERIALS/PHYSICAL PROTECTION DEVICES
Multiple application coded switch development report, 4:39260 (SAND-79-0329)
FISSILE MATERIALS/TRANSPORT
Multiple application coded switch development report, 4:39260 (SAND-79-0329)
FISSION/POTENTIAL ENERGY
Experimental survey of the potential energy surfaces associated with fission (Mass and axial symmetry, probability), 4:39938 (LA-UR-79-533)
FISSION FRAGMENTS
See also HYPERNUCLEI
NUCLEAR FRAGMENTS
FISSION FRAGMENTS/ENERGY SPECTRA
Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium, 4:39924
FISSION PRODUCT RELEASE/MATHEMATICAL MODELS
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38817 (NUREG/CR-0698)
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38816 (NUREG/CR-0697)
FISSION PRODUCTS/FISSION YIELD
Fission product yields from 6-9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis, 4:39926 (AD-A-059327)
FISSION PRODUCTS/INVENTORIES
User's guide to the reactor inventory code RICE, 4:38725 (RD-B-N-4079)
FISSIONABLE MATERIALS MANAGEMENT
See NUCLEAR MATERIALS MANAGEMENT
FLAT PLATE COLLECTORS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
FLAT PLATE COLLECTORS/CERTIFICATION
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
FLAT PLATE COLLECTORS/COVERINGS
Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974-31 January 1976, 4:38495 (PB-283783)
FLAT PLATE COLLECTORS/FABRICATION
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
FLAT PLATE COLLECTORS/HEAT EXCHANGERS
Small particle heat exchangers, 4:38407 (LBL-7841)
FLAT PLATE COLLECTORS/HEAT LOSSES
Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974-31 January 1976, 4:38495 (PB-283783)
FLAT PLATE COLLECTORS/HONEYCOMB STRUCTURES
Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974-31 January 1976, 4:38495 (PB-283783)
FLAT PLATE COLLECTORS/PERFORMANCE TESTING
Comparison of three experimental methods used in determining the thermal performance of flat-plate solar collectors. Ph.d. thesis - Kansas Univ, 4:38493 (N-78-28614)
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
Long term weathering effects on the thermal performance of the Solaron (air) solar collector, 4:38488 (DOE/NASA/CR-161166)
Provisional flat plate solar collector testing procedures: first revision. Interim report, 4:38494 (PB-283721)
FLAT PLATE COLLECTORS/WEATHERING
Long term weathering effects on the thermal performance of the Solaron (air) solar collector, 4:38488 (DOE/NASA/CR-161166)
FLORIDA/ECONOMIC ANALYSIS
Historic and current energy analysis of Florida, 4:38861 (DOE/TIC-10108)
FLORIDA/ENERGY ANALYSIS
Historic and current energy analysis of Florida, 4:38861 (DOE/TIC-10108)
FLORIDA/RESOURCE CONSERVATION
The West Indian manatee (Trichechus manatus) in Florida: a summary and analysis of biological, ecological, and administrative problems affecting preservation and restoration of the population. Final report, 4:39609 (PB-285410)
FLOW (FLUID)
See FLUID FLOW
FLOWMETERS
Estimation and reduction of errors in flow measurements which use cross-correlation techniques, 4:38741
FLOWMETERS/FLOWMETERS
Development of in-vessel reflood instrumentation at ORNL (PWR), 4:38794 (CONF-790340-1)
FLUE GAS/DENITRIFICATION
Control of nitrogen oxides from stationary source effluents (Patent), 4:39356
Process and apparatus for controlled recycling of combustion gases (Patent), 4:39349
FLUE GAS/DESULFURIZATION
Carbonaceous fuel combustion with improved desulfurization (Patent), 4:38608
Characterization of carbide lime to identify sulfite oxidation inhibitors. Final report Sep 77-Jul 78, 4:38606 (PB-286646)
Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April-December 1977, 4:38602 (PB-284045)
Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974-June 1977, 4:39045 (PB-284200)
Process for pressure stripping of sulfur dioxide from buffered solutions (Patent), 4:39357

Process for removing sulfur dioxide from waste gases (Patent), 4:38607
Review of new source performance standards for coal-fired utility boilers. Volume I. Emissions and non-air quality environmental impacts, 4:38605 (PB-285854)
FLUE GAS/SCRUBBING
CEA variable-throat venturi scrubber evaluation. Final report, May 1977-December 1977 (CEA = Combustion Equipment Associates), 4:38604 (PB-285723)
FLUID FLOW
See also TURBULENT FLOW
FLUID FLOW/PRESSURE MEASUREMENT
Analytic derivation of static pressure distribution in fully developed helical flows, 4:39328
FLUID FLOW/TURBULENT FLOW
Experimental determination of probe-length requirements for studies of the turbulent wake behind a cylinder, 4:39511
FLUID MECHANICS
See also HYDRODYNAMICS
MAGNETOGASDYNAMICS
FLUID MECHANICS/CALCULATION METHODS
Appendices to "On the dependence of necking upon loading history", 4:39806 (UCID-18161)
FLUIDIZATION/MEASURING INSTRUMENTS
Simple probe for fluidized bed measurements0, 4:39808
FLUIDIZED BED
Removal of fine particulates from gases in fluidized beds, 4:39350
FLUIDIZED BED/DUST COLLECTORS
Removal of fine particulates from gases in fluidized beds, 4:39350
FLUIDIZED BED/MONITORING
Simple probe for fluidized bed measurements0, 4:39808
FLUIDIZED-BED COMBUSTION/MEETINGS
Proceedings of the fifth international conference on fluidized bed combustion. Volume 1: overview, 4:38125 (M-78-68(Vol.1))
FLUIDIZED-BED COMBUSTION/RESEARCH PROGRAMS
Proceedings of the fifth international conference on fluidized bed combustion. Volume 1: overview, 4:38125 (M-78-68(Vol.1))
FLUIDIZED-BED COMBUSTORS
Carbonaceous fuel combustion with improved desulfurization (Patent), 4:38608
FLUIDIZED-BED COMBUSTORS/GAS ANALYSIS
Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB-284041)
FLUIDS
See also GASES
GEOTHERMAL FLUIDS
HEAT TRANSFER FLUIDS
LIQUIDS
FLUIDS/STATISTICAL MECHANICS
Semiclassical statistical mechanics of fluids: Nonperturbative incorporation of quantum effects in classical many body models, 4:39807
FLUORIDES/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
FLUORIDES/ENVIRONMENTAL EFFECTS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
FLUORINATED ALIPHATIC HYDROCARBONS
See also CARBON TETRAFLUORIDE
Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL-82181)
FLUORINE/ATOM-MOLECULE COLLISIONS
Molecular beam studies of unimolecular reactions: Cl, F + C_2H_5Br (Angular and velocity distributions, mechanism), 4:39794 (LBL-7686)
FLUORINE/COLLISIONS
Molecular beam study of the kinetics of the fluorine-uranium dioxide reaction, 4:39782
FLUORINE/DESORPTION
Analysis of chemistry at ionically bonded surfaces by electron stimulated desorption(a), 4:39225 (LBL-8975)
FLUORINE/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)
FLUORINE/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
FLUORINE 18/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
FLUORITE/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
FLUORITE/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
FLUXOIDS
See MAGNETIC FLUX
FLY ASH
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
FLY ASH/CHEMICAL ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
FLY ASH/FILTRATION
Model for coal fly ash filtration, 4:39550
FLY ASH/USES
A fire retardant froth foam seal topping system for the USBM remote mine sealing system. volume I. Final report Jun 75-Aug 77, 4:38104 (PB-286988)
FLY ASH/WASTE DISPOSAL
Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB-284013)
FLYWHEELS/DESIGN
Development of composite flywheels for energy storage and gyroscopic controls. Interim report Jul 76-Apr 77, 4:38833 (AD-A-059736)
Variable inertia flywheel as an energy storage system, 4:38835
FLYWHEELS/FABRICATION
Development of composite flywheels for energy storage and gyroscopic controls. Interim report Jul 76-Apr 77, 4:38833 (AD-A-059736)
FOG
See also WATER VAPOR
FOG/CONTROL
Research on control technology for ice fog from mobile sources, 4:39079 (PB-285611)
FOILS/ANALYTICAL SOLUTION
Self-similar power-driven expansion into vacuum, 4:40017
FOOD CHAINS/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
FORCED DRAFT COOLING TOWERS
See MECHANICAL DRAFT COOLING TOWERS
FORESTS/RESOURCE CONSERVATION
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
FORMATION PRESSURE
See RESERVOIR PRESSURE
FORT CALHOUN-1 REACTOR
See CALHOUN-1 REACTOR
FORT ST. VRAIN REACTOR
See VRAIN REACTOR
FOSSIL FUELS
See also COAL
NATURAL GAS
PETROLEUM
SYNTHETIC FUELS
FOSSIL FUELS/COMBUSTION PRODUCTS
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
FOSSIL FUELS/ENVIRONMENTAL EFFECTS
Ecosystem Studies Program, 4:39615 (ORNL-5508)
FOSSIL FUELS/ENVIRONMENTAL IMPACT STATEMENTS
Environmental Impacts Program, 4:38089 (ORNL-5508)
FOSSIL FUELS/ENVIRONMENTAL IMPACTS
Environmental Impacts Program, 4:38089 (ORNL-5508)
FOSSIL FUELS/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
FOSSIL FUELS/RESEARCH PROGRAMS
Reference data: a basic plan for research and development, 4:38509
FOSSIL-FUEL POWER PLANTS
See also ELECTRIC UTILITIES
FOSSIL-FUEL POWER PLANTS/AIR POLLUTION
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
FOSSIL-FUEL POWER PLANTS/AIR POLLUTION CONTROL
Model for coal fly ash filtration, 4:39550

FOSSIL-FUEL POWER PLANTS/BUDGETS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
FOSSIL-FUEL POWER PLANTS/CHEMICAL EFFLUENTS
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-2[illegible]5227)
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
FOSSIL-FUEL POWER PLANTS/COOLING SYSTEMS
Optimization of design specifications for large dry cooling systems. Final report, June 1975-June 1978, 4:38576 (PB-285924)
FOSSIL-FUEL POWER PLANTS/ELECTROSTATIC PRECIPITATORS
Rapping reentrainment in a near full scale pilot electrostatic precipitator. Final report May 1975-April 1978, 4:38603 (PB-284452)
FOSSIL-FUEL POWER PLANTS/ENERGY SUPPLIES
Marketing prospects for western coal, with a supplementary report on the economics of synthetic fuels from coal. Final report, 4:38129 (PB-285944)
FOSSIL-FUEL POWER PLANTS/ENVIRONMENTAL EFFECTS
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
FOSSIL-FUEL POWER PLANTS/ENVIRONMENTAL IMPACTS
Review of new source performance standards for coal-fired utility boilers. Volume I. Emissions and non-air quality environmental impacts, 4:38605 (PB-285854)
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
FOSSIL-FUEL POWER PLANTS/FEEDWATER
Water recycle/reuse alternatives in coal-fired steam-electric power plants. Volume II. Appendixes. Final report June 1975-February 1978, 4:38571 (PB-284676)
FOSSIL-FUEL POWER PLANTS/FINANCIAL INCENTIVES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
FOSSIL-FUEL POWER PLANTS/FLUE GAS
CEA variable-throat venturi scrubber evaluation. Final report, May 1977-December 1977 (CEA = Combustion Equipment Associates), 4:38604 (PB-285723)
Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April-December 1977, 4:38602 (PB-284045)
Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974-June 1977, 4:39045 (PB-284200)
Review of new source performance standards for coal-fired utility boilers. Volume I. Emissions and non-air quality environmental impacts, 4:38605 (PB-285854)
FOSSIL-FUEL POWER PLANTS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
FOSSIL-FUEL POWER PLANTS/FUEL SYSTEMS
Measurement of pulverized fuel flow to burners using an acoustic technique, 4:38569 (N-78-28387)
FOSSIL-FUEL POWER PLANTS/HYBRID SYSTEMS
Technical and economic assessment of solar hybrid repowering. Final report, 4:38409 (SAN-1608-4-2)
FOSSIL-FUEL POWER PLANTS/MEETINGS
Contributions: power plants, 1977, 4:38565 (CONF-7708110-)
FOSSIL-FUEL POWER PLANTS/RETROFITTING
Technical and economic assessment of solar hybrid repowering. Final report, 4:38409 (SAN-1608-4-2)
FOSSIL-FUEL POWER PLANTS/SCRUBBERS
Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April-December 1977, 4:38602 (PB-284045)
FOSSIL-FUEL POWER PLANTS/SITE SELECTION
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
Power plant siting (A bibliography with abstracts). Report for 1964-September 1978, 4:38760 (NTIS/PS-78/1007)
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
FOSSIL-FUEL POWER PLANTS/SOCIO-ECONOMIC FACTORS
Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB-283809)
FOSSIL-FUEL POWER PLANTS/THERMAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
FOWL/PROCESSING
Water reuse in poultry processing, 4:39044 (PB-283695)
FR-2 REACTOR/REACTOR OPERATION
Operation and utilization of the FR2 in 1977. Abbreviated version, 4:38784 (KFK-EXT-15/78-1)
FREE ELECTRON LASERS/DESIGN
Free electron laser and its possible developments, 4:39474 (BNL-25857)
FREE ELECTRON LASERS/SIMULATION
Simulations of free electron laser, 4:39289 (LA-UR-79-675)
FREE RADICALS
See RADICALS
FREQUENCY CONVERTERS/DESIGN
RDA ruby laser frequency doubler system. Quarterly progress report no. 3, 24 oct 73-23 jan 74, 4:39281 (AD-923260)
FRESH WATER ECOSYSTEMS
See AQUATIC ECOSYSTEMS
FRUITS
(Edible parts of plants only.)
FRUITS/PROCESSING
Reclamation and reuse of fruit processing wastewater, 4:39043 (PB-283694)
FT. CALHOUN-1
See CALHOUN-1 REACTOR
FTR REACTOR
See FFTF REACTOR
FUEL ASSEMBLIES
See also FUEL ELEMENT CLUSTERS
FUEL ASSEMBLIES/FLUID FLOW
Noise and DC balanced outlet temperature signals for monitoring coolant flow in LMFBR fuel elements, 4:38692
FUEL ASSEMBLIES/HEAT TRANSFER
Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system (LMFBR), 4:38684 (NUREG/CR-0001)
FUEL ASSEMBLIES/HYDRAULICS
Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system (LMFBR), 4:38684 (NUREG/CR-0001)
FUEL BUNDLES
See FUEL ELEMENT CLUSTERS
FUEL CANS/CRACKS
Preliminary experiment on crack propagation in zircaloy-cladding. Failure behavior of zircaloy-cladding, (1), 4:38807 (JAERI-M-7453)
FUEL CANS/ELECTROMAGNETIC TESTING
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
FUEL CANS/TESTING
Selected advances in materials research, 4:39106 (CONF-790343-1)
FUEL CELLS
See also HYDROCARBON FUEL CELLS
HYDROGEN FUEL CELLS
FUEL CELLS/ELECTROCHEMISTRY
Electrochemical reactions at surfaces. Volume 1. 1964-1975 (a bibliography with abstracts). Report for 1964-75, 4:39247 (NTIS/PS-78/1033)
Electrochemical reactions at surfaces. volume 2. 1976-September, 1978 (a bibliography with abstracts). Report for 1976-September 1978, 4:39248 (NTIS/PS-78/1034)
FUEL CELLS/OPTIMIZATION
Evaluation and optimization of solid polymer electrolyte (SPE) fuel cells. Final technical report, 23 May 1977-23 April 1978, 4:38987 (AD-A-058380)
FUEL CELLS/PERFORMANCE TESTING
Evaluation and optimization of solid polymer electrolyte (SPE) fuel cells. Final technical report, 23 May 1977-23 April 1978, 4:38987 (AD-A-058380)
FUEL CONSUMPTION/MEASURING INSTRUMENTS
Fuel consumption measuring device (Patent), 4:39061
FUEL COOLING INSTALLATIONS
See SPENT FUEL STORAGE
FUEL CYCLE
See also THORIUM CYCLE
FUEL CYCLE/ENVIRONMENTAL IMPACTS
Environmental Impacts Program, 4:38089 (ORNL-5508)
FUEL CYCLE/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
FUEL ELEMENT CLUSTERS/FLOW BLOCKAGE
In-pile investigation of local cooling disturbance in LMFBR's (Mol 7C), 4:38803 (INIS-mf-4426)
FUEL ELEMENT CLUSTERS/HYDRAULICS
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1978-November 30, 1978, 4:38664 (COO-2245-66)

Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1978-August 31, 1978, 4:38663 (COO-2245-65)
FUEL ELEMENT CLUSTERS/TEMPERATURE DISTRIBUTION
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1978-November 30, 1978, 4:38664 (COO-2245-66)
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1978-August 31, 1978, 4:38663 (COO-2245-65)
FUEL ELEMENT FAILURE
Theoretical and experimental investigation of the nonlinear structural dynamics of Fast Breeder Reactor fuel elements, 4:38679 (KFK-2584)
FUEL ELEMENT FAILURE/SIMULATION
Behavior of a failed fuel rod during film boiling operation (PWR), 4:38797 (CONF-790602-3)
Fuel rod behavior in a nine-rod bundle tested in film boiling (PWR), 4:38796 (CONF-790602-2)
FUEL ELEMENTS
See also FUEL ASSEMBLIES
FUEL CANS
FUEL PINS
FUEL RODS
NUCLEAR FUELS
FUEL ELEMENTS/HEAT TRANSFER
Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation, 4:38680 (KFK-2619)
FUEL ELEMENTS/PERFORMANCE
Fuel performance improvement program. Quarterly progress report October-December 1978 (BWR;PWR), 4:38624 (COO-4066-9)
FUEL ELEMENTS/PERFORMANCE TESTING
GSB fuel element review meeting, 4:38677 (INIS-mf-4426)
Qualification of HTGR fuel by rig development and irradiation testing at BR2 Mol, 4:38640 (INIS-mf-4426)
FUEL FEEDING SYSTEMS/PERFORMANCE TESTING
Coal feeder development. Phase II report, 4:38054 (FE-1793-46)
FUEL GAS
See also HIGH BTU GAS
INTERMEDIATE BTU GAS
LOW BTU GAS
FUEL GAS/FUEL SUBSTITUTION
Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
FUEL GAS/PURIFICATION
Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, May 1-July 31, 1978, 4:38046 (ACD-38391-12)
FUEL GAS/YIELDS
Basic studies of coal pyrolysis and hydrogasification. Quarterly progress report, April 1-June 30, 1978, 4:38080 (FE-MIT-2295T26-6)
FUEL INJECTION SYSTEMS/DESIGN
Electric fuel injection valve (Patent), 4:39068
Fuel injection system (Patent), 4:39062
Fuel-oil mixing apparatus for internal-combustion engines (Patent), 4:39069
FUEL OILS/FLUIDIZED-BED COMBUSTION
Carbonaceous fuel combustion with improved desulfurization (Patent), 4:38608
FUEL OILS/HYDROGENATION
Process for liquefying coal (Patent), 4:38079
FUEL PARTICLES
See also COATED FUEL PARTICLES
FUEL PARTICLES/PRODUCTION
Sol-gel sphere-pac activities for the fuel refabrication and development program. Quarterly progress report for period ending December 31, 1977, 4:38227 (ORNL/TM-6746)
FUEL PINS/MELTDOWN
Fuel pin behavior during UO_2 pellet melting, 4:38808 (JAERI-M-7503)
FUEL PINS/PERFORMANCE TESTING
HEDL mixed oxide fuel pin breach experience in EBR-II, 4:38669 (HEDL-SA-1535-FP)
Mixed oxide run-beyond-cladding-breach tests in EBR-II, 4:38670 (HEDL-SA-1536-FP)
Short terms experiments in BR2 towards a better fast fuel performance analysis, 4:38675 (INIS-mf-4426)
Steady state irradiation behavior of mixed oxide fuel pins irradiated in EBR-II (LMFBR), 4:38672 (HEDL-SA-1683-FP)
FUEL PINS/RADIONUCLIDE MIGRATION
Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA-1543-FP)
FUEL PINS/SIMULATION
Fuel pin simulators for sodium boiling tests in the THORS facility, 4:38687 (ORNL/TM-6688)
FUEL REPROCESSING PLANTS
See also IDAHO CHEMICAL PROCESSING PLANT
FUEL REPROCESSING PLANTS/OFF-GAS SYSTEMS
Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report, 4:38243 (IDO-1540-T1)
FUEL REPROCESSING PLANTS/RADIOACTIVE WASTES
Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976, 4:38251 (IAEA-209)
FUEL RODS/PERFORMANCE
FFRS: A computer program for the thermal and mechanical analysis of fuel rods (BWR;PWR), 4:38627 (RISO-373)
FUEL RODS/POWER DISTRIBUTION
Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis, 4:38750 (NUREG/CR-0220)
FUEL RODS/PRODUCTION
Sol-gel sphere-pac activities for the fuel refabrication and development program. Quarterly progress report for period ending December 31, 1977, 4:38227 (ORNL/TM-6746)
FUEL RODS/RELIABILITY
FFRS: A computer program for the thermal and mechanical analysis of fuel rods (BWR;PWR), 4:38627 (RISO-373)
FUEL RODS/TEMPERATURE DISTRIBUTION
Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis, 4:38750 (NUREG/CR-0220)
FUEL SUBSTITUTION
Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
FUEL SYSTEMS
See also FUEL FEEDING SYSTEMS
FUEL INJECTION SYSTEMS
FUEL SYSTEMS/DESIGN
Study of fuel systems for LH2-fueled subsonic transport aircraft. Volume 1. Final report, September 1976-December 1977, 4:39017 (N-78-31085)
Study of fuel systems for LH2-fueled subsonic transport aircraftVolume 2. Final report, September 1976-December 1977, 4:39018 (N-78-31086)
FUEL SYSTEMS/PLANNING
Automated fuel dispensing for state and local governments, 4:39026 (PB-283974)
FUEL-CLADDING INTERACTIONS
Chemical interaction at the FBR cladding fuel interfaces, 4:38674 (INIS-mf-4426)
FUELS
See also AUTOMOTIVE FUELS
FOSSIL FUELS
FUEL GAS
HYDROGEN FUELS
JET ENGINE FUELS
NUCLEAR FUELS
SYNTHETIC FUELS
FUELS/DISTRIBUTION
Automated fuel dispensing for state and local governments, 4:39026 (PB-283974)
FUME HOODS/DESIGN
Energy conserving fume hood (Patent), 4:39035
FUMES
See AEROSOLS
FURNACES
See also GAS GENERATORS
WOOD BURNING FURNACES
Physical modeling of joule heated ceramic glass melters for high level waste immobilization, 4:38256 (PNL-2809)
FURNACES/AFTERBURNERS
After -burner for flue gas from solid, liquid or gaseous materials (Patent), 4:39257
FURNACES/HEAT TRANSFER
Method and apparatus for effecting uniform heat transfer in an industrial furnace (Patent), 4:39345
FUSED SALTS
See MOLTEN SALTS
FUSION REACTORS
See THERMONUCLEAR REACTORS

G

GADOLINIUM SELENIDES/COMPATIBILITY
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM-6660)
GALACTIC EVOLUTION/ELLIPTICAL CONFIGURATION
Model of the formation of elliptical galaxies, 4:39755
GALAXY NUCLEI/NEUTRON BEAMS
Neutron beams in active galactic nuclei, 4:39754
GALLIUM ANTIMONIDES/PHOTOELECTRON SPECTROSCOPY
Photoemission study of Al/III-V interfaces, 4:39953
GALLIUM ARSENIDE SOLAR CELLS/DESIGN
Basic mechanisms study for MIS solar cell structures on GaAs. Final report, 4:38383 (N-78-28601)
GALLIUM ARSENIDE SOLAR CELLS/GRAIN BOUNDARIES
Effect of grain boundaries on the performance of polycrystalline tunnel MIS solar cells, 4:38395
GALLIUM ARSENIDE SOLAR CELLS/POLYCRYSTALS
Effect of grain boundaries on the performance of polycrystalline tunnel MIS solar cells, 4:38395
GALLIUM ARSENIDE SOLAR CELLS/TUNNEL EFFECT
Effect of grain boundaries on the performance of polycrystalline tunnel MIS solar cells, 4:38395
GALLIUM ARSENIDES/INTERFACES
Angle resolved photoemission studies of the GaAs-Ge interface, 4:39954
GALLIUM ARSENIDES/PHOTOELECTRON SPECTROSCOPY
Photoemission study of Al/III-V interfaces, 4:39953
GALLIUM ARSENIDES/PHOTOEMISSION
Angle resolved photoemission studies of the GaAs-Ge interface, 4:39954
GAMMA DOSIMETRY/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
GAMMA FUNCTION/COMPUTER CALCULATIONS
Computer methods for sampling from the gamma distribution, 4:40039 (LA-UR-78-2116)
GAMMA RADIATION/COMPARATIVE EVALUATIONS
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL-25730)
GAMMA RADIOGRAPHY/IMAGES
Method of recording radiographic images (Patent), 4:39329
GAMMA SOURCES
(See also specific radioisotopes.)
GAMMA SOURCES/CALIBRATION
Multigamma-ray calibration sources (Tables), 4:39942 (M-100)
GAMMA SOURCES/DATA COMPILATION
Multigamma-ray calibration sources (Tables), 4:39942 (M-100)
GAMMA SPECTROMETERS/CALIBRATION
Multigamma-ray calibration sources (Tables), 4:39942 (M-100)
GAMMA SPECTROSCOPY
Fine gamma spectrometry and release measurements, 4:39495
GAMMA-RAY LASERS/BIBLIOGRAPHIES
Bibliography of GRASER research. Informal report, 4:39288 (LA-7783-MS)
GAS ANALYSIS
Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB-284041)
GAS BURNERS/CONTROL SYSTEMS
Apparatus and method to control process to replace natural gas with fuel oil in a natural gas burner (Patent), 4:39346
GAS BURNERS/OPERATION
Method and apparatus to replace natural gas with vaporized fuel oil in a natural gas burner (Patent), 4:39348
GAS CHROMATOGRAPHY/CAPILLARIES
Practical aspects of glass capillary gas chromatography, 4:39214 (CONF-790330-1)
GAS COOLANTS
See GASES
GAS COOLED FAST BREEDER REACTORS
See GCFR TYPE REACTORS
GAS ENGINES
See INTERNAL COMBUSTION ENGINES
GAS FUELED REACTORS/CRITICAL MASS
Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission), 4:38788
GAS GENERATORS/DESIGN
Hot fuel gas generator (Patent), 4:39058
GAS GENERATORS/TECHNOLOGY ASSESSMENT
Generator gas: the Swedish experience from 1939-1945, 4:39090 (SERI/SP-33-140)
GAS HYDRATES/REMOVAL
Natural gas dehydration with solid desiccant, 4:38176 (CONF-7611113-)
GAS LASERS
See also CARBON DIOXIDE LASERS
GAS LASERS/DESIGN
Cathode electrode configuration for gas laser system (Patent), 4:39299
Multi stage q-switched iodine laser. Master's thesis, 4:39282 (AD-A-057904)
GAS LASERS/DISSOCIATION
Sulfur $^1S_0$-$^1D_2$ laser by OCS photodissociation, 4:39295
GAS LASERS/ELECTRICAL PUMPING
Cathode electrode configuration for gas laser system (Patent), 4:39299
GAS LASERS/ELECTRON GUNS
Recent advances in cold cathode technology as applied to high power lasers, 4:39287 (CONF-771035-P2)
GAS LASERS/EMISSION SPECTRA
Characteristics of amplified spontaneous emissions in high-gain gas-laser amplifiers, 4:39322
GAS LASERS/GAIN
Characteristics of amplified spontaneous emissions in high-gain gas-laser amplifiers, 4:39322
GAS LASERS/LASER CAVITIES
Laser plasma tube having internal gas path (Patent), 4:39302
GAS LASERS/MATHEMATICAL MODELS
Theoretical modelling of charge transfer lasers, 4:39321
GAS LASERS/NUCLEAR PUMPING
Recent advances in cold cathode technology as applied to high power lasers, 4:39287 (CONF-771035-P2)
GAS LASERS/OPERATION
Relation of the average energy of complex molecules combining by absorption and emission, 4:39320
Transverse electrically excited iodine laser, 4:39325
GAS LASERS/REVIEWS
Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77, 4:39284 (AD-A-059429)
GAS LASERS/SUPPORTS
Gas discharge laser device (Patent), 4:39301
GAS LASERS/USES
Study of infrared and visible gas lasers. Final report 1 oct 74-30 sep 77, 4:39284 (AD-A-059429)
GAS TUNGSTEN-ARC WELDING
TIG and plasma welding (Book), 4:39100
GAS TURBINES/ALCOHOL FUELS
Comparison of projected electric-utility peaking-gas-turbine energy requirements to potential alcohol fuels availability: 1980-2000, 4:38591 (HCP/M2098-02)
GAS TURBINES/COMBUSTORS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
GAS TURBINES/DESIGN
Gas turbine (Patent), 4:39075
Gas turbine construction and combustion process carried out in gas turbine (Patent), 4:38589
GAS TURBINES/EROSION
Laser-particulate control for open-cycle, coal fired gas turbines, 4:38601 (BNL-25587)
GAS TURBINES/FUEL ECONOMY
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
GAS TURBINES/FUEL INJECTION SYSTEMS
Detector and process for determining discontinuity of flow in a gas turbine drive (Patent), 4:38588
GAS TURBINES/POLLUTION CONTROL EQUIPMENT
Gas turbine (Patent), 4:39075
GAS TURBINES/POWER GENERATION
Gas-turbine electric plant construction cost and annual production expenses, 1976. Energy data report fourth annual supplement (520 plants), 4:38590 (DOE/EIA-0180)
GAS TURBINES/RESEARCH PROGRAMS
Development of high temperature turbine subsystem technology to a "technology readiness status", phase II. Progress report, March 1979, 4:38579 (FE-1806-65)
GAS TURBINES/ROTORS
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
GAS TURBINES/TECHNOLOGY ASSESSMENT
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
GAS TURBINES/WASTE HEAT
Apparatus for hot gas heat transfer particularly for paper drying (Patent), 4:39042
GAS UTILITIES/FUEL SUBSTITUTION
Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
GASEOUS DIFFUSION PLANTS/AIR POLLUTION
Terrestrial Ecology Section, 4:38091 (ORNL-5508)

GASEOUS DIFFUSION PLANTS/ENVIRONMENTAL EFFECTS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
GASEOUS DIFFUSION PLANTS/INVENTORIES
Minor isotope measurements for safeguarding a uranium enrichment plant, 4:38290 (K/OA-4488)
GASEOUS DIFFUSION PLANTS/SAFEGUARDS
Minor isotope measurements for safeguarding a uranium enrichment plant, 4:38290 (K/OA-4488)
GASEOUS WASTES
See also FLUE GAS
GASEOUS WASTES/DENITRIFICATION
Method for removing nitrogen oxides from nitrogen oxide-containing gases (Patent), 4:39353
Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas (Patent), 4:39355
Separating gaseous nitrogen oxides from other gases by paramagnetic separation in a liquid media (Patent), 4:39354
GASEOUS WASTES/RADIATION MONITORING
Concept for the monitoring of airborne radioactive effluents from nuclear plants in the Federal Republic of Germany with application to the Juelich Nuclear Research Center, 4:38768
Experience of measuring radioactive iodine by the cumulative method in gaseous discharges from nuclear power stations, 4:38737
Monitoring of airborne releases from LWR power plants in the Federal Republic of Germany, 4:38777
GASEOUS WASTES/SAMPLING
General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities, 4:38288
GASES
See also AIR
COAL GAS
NATURAL GAS
GASES/SELF-DIFFUSION
Scaled Boltzmann theory for k-dependent test particle correlation functions in moderately dense gases), 4:39961
GASIFICATION
See also COAL GASIFICATION
IN-SITU GASIFICATION
GASIFICATION/COAL GASIFICATION
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
GASOLINE
See also MOBIL M-GASOLINE PROCESS
GASOLINE/CHARGES
Motor gasoline prices through 1980 under continued DOE price controls, 4:38916 (DOE/EIA-0102/39)
GASOLINE/PERFORMANCE TESTING
Ethanol/gasoline blends as automotive fuel, 4:39089 (BETC/RI-79/2)
GASTEROPODS
See MOLLUSCS
GAUGE INVARIANCE/SU-2 GROUPS
Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model, 4:39869
GAUGE INVARIANCE/SU-4 GROUPS
Lattice-gauge-theory spectrum for broken SU(4), 4:39837
GAUGE INVARIANCE/U-1 GROUPS
Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model, 4:39869
GCFR TYPE REACTORS/BREEDING BLANKETS
MIT LMFBR blanket research project. Quarterly progress report, October 1-December 31, 1978, 4:38665 (COO-2250-35)
GCFR TYPE REACTORS/FUEL ELEMENTS
GSB fuel element review meeting, 4:38677 (INIS-mf-4426)
GENE RECOMBINATION/RADIOINDUCTION
Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast, 4:39659 (UR-3490-1568)
GENERATORS (ELECTRIC)
See ELECTRIC GENERATORS
GENERATORS (STEAM)
See STEAM GENERATORS
GENETIC VARIABILITY/MODIFICATIONS
Genetic modification and plant productivity, 4:39651
GEOMAGNETIC FIELD/PULSATIONS
A catalog of low-frequency oscillations of the earth's magnetic field as observed at SMS-1 during November 1974-March 1975. Data report, 4:39767 (PB-286773)
GEOMAGNETIC FIELD/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
GEOMAGNETIC STORMS
See MAGNETIC STORMS
GEOPHONES
See SEISMIC DETECTORS
GEOPHYSICS/BIBLIOGRAPHIES
Earth Sciences Division, collected abstracts, 1978, 4:39706 (UCRL-52681)
GEOPRESSURED SYSTEMS/MAPS
Geopressured-geothermal energy in reservoir fluids of the northern Gulf of Mexico Basin. Map 3 of U.S. Geological Survey Circular 790, 4:38516
GEOTHERMAL DISTRICT HEATING
Recent developments in geothermal multipurpose utiliztaion in Jozankei Hot Springs in Sapporo City, 4:38552
GEOTHERMAL DISTRICT HEATING/FEASIBILITY STUDIES
Geothermal application feasibility study for the New Mexico State University campus. Technical report, 4:38550 (NMEI-13)
GEOTHERMAL ENERGY/RESEARCH PROGRAMS
A consideration of geothermal energy, 4:38529
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
Reference data: a basic plan for research and development, 4:38509
GEOTHERMAL ENERGY CONVERSION/MARKETING RESEARCH
A market survey of geothermal wellhead power generation systems. Final report, 4:38535 (N-78-27533)
GEOTHERMAL ENERGY CONVERSION/THERMODYNAMICS
Available work in geothermal energy, 4:38531 (COO-4051-25)
GEOTHERMAL FIELDS
See also EAST MESA GEOTHERMAL FIELD
KRAFLA GEOTHERMAL FIELD
NAMAFJALL GEOTHERMAL FIELD
GEOTHERMAL FLUIDS
See also BRINES
THERMAL WATERS
GEOTHERMAL FLUIDS/CHEMICAL COMPOSITION
Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL-52640)
GEOTHERMAL FLUIDS/CORROSIVE EFFECTS
Construction and thermodynamic performance of an Ag-AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
GEOTHERMAL FLUIDS/SCALING
Studies of brine chemistry, precipitation of solids, and scale formation at the Salton Sea geothermal field, 4:38545 (UCRL-52640)
GEOTHERMAL FLUIDS/WATER CHEMISTRY
Construction and thermodynamic performance of an Ag-AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
GEOTHERMAL POWER PLANTS/CAPACITY
Status of geothermal energy development in 1976, 4:38536
GEOTHERMAL POWER PLANTS/CHEMICAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
GEOTHERMAL POWER PLANTS/DIRECT CONTACT HEAT EXCHANGERS
Study and testing of direct contact heat exchangers for geothermal brines. Phase II, August 1976-June 1977, 4:38542 (ORO-4893-2)
GEOTHERMAL POWER PLANTS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
GEOTHERMAL POWER PLANTS/MARKET
Market survey of geothermal wellhead power generation systems. Final report, March 1978, 4:38528 (HCP/T1021-36)
GEOTHERMAL POWER PLANTS/MARKETING RESEARCH
A market survey of geothermal wellhead power generation systems. Final report, 4:38535 (N-78-27533)
GEOTHERMAL POWER PLANTS/OPERATION
Geothermal Loop Experimental Facility. Quarterly report, April-June 1978, 4:38540 (SAN-1137-11)
GEOTHERMAL POWER PLANTS/REVIEWS
Geothermal energy technology, 4:38544
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO-4051-38)
Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations, 4:38534 (COO-4051-41)
Geothermal power plants of Italy: A technical survey of existing installations, 4:38538 (COO-4051-34)
GEOTHERMAL POWER PLANTS/SPECIFICATIONS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
GEOTHERMAL POWER PLANTS/TEST FACILITIES
Geothermal Loop Experimental Facility. Quarterly report, January-March 1978, 4:38543 (SAN-1137-10)

Geothermal Loop Experimental Facility. Quarterly report, April-June 1978, 4:38540 (SAN-1137-11)
GEOTHERMAL POWER PLANTS/THERMAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
GEOTHERMAL RESOURCES/ENVIRONMENTAL IMPACTS
1978 annual report, INEL geothermal environmental program, 4:38530 (TREE-1340)
Environmental Impacts Program, 4:38089 (ORNL-5508)
GEOTHERMAL RESOURCES/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
GEOTHERMAL SPACE HEATING/FEASIBILITY STUDIES
Geothermal application feasibility study for the New Mexico State University campus. Technical report, 4:38550 (NMEI-13)
GEOTHERMAL SYSTEMS
See also GEOPRESSURED SYSTEMS
HOT-DRY-ROCK SYSTEMS
HYDROTHERMAL SYSTEMS
GEOTHERMAL SYSTEMS/GEOLOGIC STRUCTURES
Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1977-August 31, 1978, 4:38520 (COO-2534-4)
GEOTHERMAL SYSTEMS/MATHEMATICAL MODELS
Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies, 4:38512 (LBL-8802)
GEOTHERMAL SYSTEMS/SEISMIC SURVEYS
Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1977-August 31, 1978, 4:38520 (COO-2534-4)
GEOTHERMAL SYSTEMS/SIMULATORS
Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies, 4:38512 (LBL-8802)
GEOTHERMAL SYSTEMS/TWO-PHASE FLOW
Description of the three-dimensional two-phase simulator shaft78 for use in geothermal reservoir studies, 4:38512 (LBL-8802)
GEOTHERMAL WELLS/EVALUATION
Evaluation of Coso Geothermal Exploratory Hole No. 1 (CGEH-1) Coso Hot Springs: KGRA, China Lake, CA, 4:38526 (LBL-8675)
GEOTHERMAL WELLS/GAIN
Development of integrated thermionic circuits for geothermal high-temperature applications, 4:38525 (LA-UR-79-723)
GEOTHERMAL WELLS/PERFORMANCE TESTING
Results of reservoir engineering tests, 1977, East Mesa, California, 4:38546 (LBL-7091)
GEOTHERMAL WELLS/WELL LOGGING
Geothermal well log interpretation midterm report, 4:38524 (LA-7693-MS)
GEOTHERMAL WELLS/WELL LOGGING EQUIPMENT
Technology development for high temperature logging tools, 4:38527 (SAND-79-0013C)
GERMAN FEDERAL REPUBLIC/ENERGY DEMAND
Activity report for the period between July 1 and September 31, 1977, 4:38911 (NP-23704)
GERMAN FEDERAL REPUBLIC/ENERGY POLICY
Energy policy prospects as viewed by the Federal Government, 4:38924
Possibilities and limits of energy conservation in the Federal Republic, 4:38898
GERMAN FEDERAL REPUBLIC/ENERGY SUPPLIES
Activity report for the period between July 1 and September 31, 1977, 4:38911 (NP-23704)
GERMAN FEDERAL REPUBLIC/GERMAN FEDERAL REPUBLIC
Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134
GERMAN FEDERAL REPUBLIC/NATURAL GAS DEPOSITS
Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134
GERMAN FEDERAL REPUBLIC/PETROLEUM DEPOSITS
Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134
GERMANIUM/ELECTRON-HOLE DROPLETS
Properties of the strain-confined electron-hole liquid in Ge as a function of density, 4:39951
GERMANIUM/INTERFACES
Angle resolved photoemission studies of the GaAs-Ge interface, 4:39954
GERMANIUM/ION COLLISIONS
K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4-3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
GERMANIUM/PHOTOEMISSION
Angle resolved photoemission studies of the GaAs-Ge interface, 4:39954
GERMANIUM/PHYSICAL RADIATION EFFECTS
Characteristics of radiation damage of silver-doped p-type germanium, 4:39164
Radiation damage profile of compensated p-type germanium irradiated with fast electrons, 4:39163
GERMANIUM ALLOYS/CHEMICAL BONDS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
GERMANIUM ALLOYS/CRYSTAL-PHASE TRANSFORMATIONS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
GERMANIUM ALLOYS/ENERGY-LEVEL DENSITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
GERMANIUM ALLOYS/FERMI LEVEL
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
GERMANIUM ALLOYS/SUPERCONDUCTIVITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
GERMANY (FEDERAL REPUBLIC)
See GERMAN FEDERAL REPUBLIC
GLASS/SORPTIVE PROPERTIES
Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB-284092)
GLIOBLASTOMAS
See NEOPLASMS
GLOBULINS
See also FIBRINOGEN
GLOBULINS/BIOCHEMICAL REACTION KINETICS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
GLYOXAL/CHEMICAL REACTIONS
Prevention of G:C pairing in mouse DNA by complete blocking of guanine residues with glyoxal. Availability of cytosine, adenine and thymine for hydrogen bonding with added unmodified polynucleotides, 4:39646
GNOME EVENT/DECOMMISSIONING
Project gnome decontamination and decommissioning plan, 4:39523 (NVO-202)
GOLD/CRYSTAL STRUCTURE
LEED analysis of the reconstructed Au(110) surface, 4:39104
GOLD/ION CHANNELING
Resonant coherent excitation of channeled ions, 4:39170
GOLD/METALLURGICAL EFFECTS
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
GOLD/MICROSTRUCTURE
Pulse plating of hard gold electrodeposits, 4:39101 (BDX-613-2165)
GOLD/MORPHOLOGY
Pulse plating of hard gold electrodeposits, 4:39101 (BDX-613-2165)
GOLD/SPUTTERING
Application of matrix isolation spectroscopy to the measurement of sputtering yields, 4:39098
GOLD/SURFACE PROPERTIES
Surface studies and catalysis , 4:39146 (LBL-8975)
GOLD/WELDABILITY
Role of surface contaminants in the deformation welding of gold to thick and thin films, 4:39093 (SAND-79-0352C)
GOLD 197 TARGET/KRYPTON 86 REACTIONS
Dynamical birth and thermal death of angular momentum in heavy ion reactions (Collective model, 600 MeV, cross sections, J), 4:39914 (LBL-8613)
GOLD 197 TARGET/OXYGEN 16 REACTIONS
Energy dependence of peripheral reactions induced by heavy ions (Differential cross sections, 140 and 315 MeV, yields), 4:39915
GOLD ALLOYS/CORROSION PROTECTION
Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
GOLD IONS/ION-ATOM COLLISIONS
Theory of electron transfer and ionization, 4:39789 (CONF-790438-1)
GRAPHITE/CHEMICAL VAPOR DEPOSITION
Development of intercalated graphite materials. Final technical report 1 August 1976-30 September 1977, 4:39186 (AD-A-057503)

GRAPHITE/DEGASSING
UHV compatibility of two possible fusion reactor materials: K-ramic/sup R/ and ATJ graphite, 4:40023
GRAPHITE/ELECTRIC CONDUCTIVITY
Development of intercalated graphite materials. Final technical report 1 August 1976-30 September 1977, 4:39186 (AD-A-057503)
GRAPHITE/FISSION PRODUCT RELEASE
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
GRAPHITE/REFLECTIVITY
Development of intercalated graphite materials. Final technical report 1 August 1976-30 September 1977, 4:39186 (AD-A-057503)
GRAPHITE/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
GRASERS
See GAMMA-RAY LASERS
GRASS/RADIONUCLIDE KINETICS
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
GRAVITY SURVEYS
See also WELL LOGGING
GRAVITY SURVEYS/CORRELATIONS
Use of data from deep seismic probing in the interpretation of gravimetric data, 4:39723
GRAVITY SURVEYS/DATA ANALYSIS
Nature of local gravitational anomalies in northern Ustyurt, 4:39722
Role of gravitational field transformations in studying deep, density separation boundaries in the precaspian depression, 4:39721
Separation of gravitational and magnetic anomalies for vertical cylindrical bodies, 4:39719
Technique and results of interpreting gravimetric data for investigating the deep geological structure of the Russian plate, 4:39720
Use of data from deep seismic probing in the interpretation of gravimetric data, 4:39723
GREASES/AIR POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
GREASES/LAND POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
GREASES/WATER POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
GREAT BRITAIN
See UNITED KINGDOM
GREAT LAKES REGION
See also ILLINOIS
INDIANA
MINNESOTA
OHIO
GREAT LAKES REGION/ENERGY SUPPLIES
Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM-40)
GREAT PLAINS/ENERGY SUPPLIES
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
GREAT PLAINS/IRRIGATION
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
GREAT PLAINS/WATER RESOURCES
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
GREENHOUSES
Rocky Mountain greenrooms, 4:38449 (CONF-780337-P2)
GREENHOUSES/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
GREENHOUSES/PASSIVE SOLAR HEATING SYSTEMS
Hybrid solar greenhouse at Cate farm, 4:38446 (CONF-780337-P2)
Noti solar greenhouse, performance and evaluation, 4:38445 (CONF-780337-P2)
Solar heated greenhouse, 4:38448 (CONF-780337-P2)
GROUND DISPOSAL
See UNDERGROUND DISPOSAL
GROUND WATER/POLLUTION
Earth Sciences, 4:38087 (ORNL-5508)
GULF OF ALASKA/OIL FIELDS
Offshore oil development in lower Cook Inlet. Implications for the Kenai Peninsula, 4:38143 (PB-284019)
GULF OF MEXICO/GEOLOGY
Earth Sciences, 4:38087 (ORNL-5508)
GULF OF MEXICO/OIL FIELDS
Environmental assessment of an active oil field in the northwestern Gulf of Mexico, 1976-1977. Annual report, 4:38165 (PB-283890)

H

HADRON-HADRON INTERACTIONS
See also NUCLEON-NUCLEON INTERACTIONS
HADRON-HADRON INTERACTIONS/INCLUSIVE INTERACTIONS
Resonant production of high-transverse-momentum back-to-back gluon jets in pp collisions (27 GeV, cross sections, transverse momentum, angular distribution, proposed experiment), 4:39851 (COO-1545-250)
HADRON-HADRON INTERACTIONS/INTERACTION RANGE
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
HADRON-HADRON INTERACTIONS/PARTICLE PRODUCTION
Parton recombination model, 4:39852 (DOE/ER/70004-207)
HADRON-HADRON INTERACTIONS/STRUCTURE FUNCTIONS
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
HADRONS
See also BARYONS
HADRONS/COLOR MODEL
Quasinuclear colored quark model for hadrons (Lectures), 4:39861 (FERMILAB-Conf-78/73-THY)
HADRONS/PARTICLE PRODUCTION
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
HADRONS/PHOTOPRODUCTION
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
HADRONS/QUANTUM CHROMODYNAMICS
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
HADRONS/QUARK MODEL
Quasinuclear colored quark model for hadrons (Lectures), 4:39861 (FERMILAB-Conf-78/73-THY)
HAFNIUM ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
HALIDES
See also CHLORIDES
FLUORIDES
HALIDES/CATALYTIC EFFECTS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
HALIDES/DISSOCIATION ENERGY
Model calculations of the thermochemical properties of gaseous metal halides. Interim report, 4:39219 (AD-A-059503)
HALIDES/THERMODYNAMIC PROPERTIES
Model calculations of the thermochemical properties of gaseous metal halides. Interim report, 4:39219 (AD-A-059503)
HALL GENERATORS
See MHD GENERATORS
HALOGENATED ALIPHATIC HYDROCARBONS
See also BROMINATED ALIPHATIC HYDROCARBONS
CHLORINATED ALIPHATIC HYDROCARBONS
FLUORINATED ALIPHATIC HYDROCARBONS
HALOGENATED ALIPHATIC HYDROCARBONS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
HALOGENATED ALIPHATIC HYDROCARBONS/ELECTRON-MOLECULE COLLISIONS
Negative ions of polyatomic molecules (Resonance, anions, electron dissociative attachment, electron capture, potential

energy, cross sections, yields, lifetime), 4:39783 (CONF-790344-1)
HAMILTON OPERATORS
See HAMILTONIANS
HAMILTONIANS/MATRIX ELEMENTS
The evaluation of matrix elements with generalized spherical Gaussian wavefunctions Part I. Single-particle, one- and two-centre forms. Technical report no. 1, 1 May 77-31 Apr 78, 4:39800 (AD-A-059533)
HANFORD RESERVATION/RADIOACTIVE WASTE DISPOSAL
Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL-1948)
HASTELLOY X/FATIGUE
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
HASTELLOY X/MATERIALS TESTING
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
HAYNES 188 ALLOY/MATERIALS TESTING
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
HAZARDOUS MATERIALS/LEACHING
Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB-285072)
HAZARDOUS MATERIALS/REMOVAL
Materials suitable for use inside explosion-proof enclosures. Final report, 7 September 1975-7 March 1976, 4:38131 (PB-283972)
HAZARDOUS MATERIALS/WASTE DISPOSAL
NATO CCMS pilot study, disposal of hazardous wastes, phase 1. Final report, 4:39048 (PB-286050)
HEALTH HAZARDS/COORDINATED RESEARCH PROGRAMS
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415-31)
HEALTH HAZARDS/RESEARCH PROGRAMS
Quarterly report of progress for the periods: 1 October 1978-31 December 1978 and 1 January 1979-31 March 1979, 4:39705 (SAND-79-0796)
HEALTH HAZARDS/RISK ASSESSMENT
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
HEALTH PHYSICS
See RADIATION PROTECTION
HEAT ENGINES
See also STIRLING ENGINES
HEAT ENGINES/DESIGN
Energy generating device (Patent), 4:39358
HEAT EXCHANGERS
See also DIRECT CONTACT HEAT EXCHANGERS
HEAT PUMPS
HEAT EXCHANGERS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
HEAT EXCHANGERS/DESIGN
Compact heat exchangers for sea thermal power plants. Final technical progress report, May 1, 1977-March 31, 1978, 4:38412 (COO-4300-7)
Small particle heat exchangers, 4:38407 (LBL-7841)
HEAT EXCHANGERS/FLUID FLOW
Review on fluid forces on circular cylinders in cross flow (LMFBR), 4:38662 (ANL-CT-79-16)
HEAT EXCHANGERS/LATENT HEAT STORAGE
Active heat exchange system development for latent heat thermal energy storage, 4:38836 (DOE/NASA/0038-79/1)
HEAT EXCHANGERS/MECHANICAL VIBRATIONS
Vibration of heat exchange components in liquid and two-phase cross-flow, 4:38731 (AECL-6184)
HEAT EXCHANGERS/OPTIMIZATION
Compact heat exchangers for sea thermal power plants. Final technical progress report, May 1, 1977-March 31, 1978, 4:38412 (COO-4300-7)
HEAT EXCHANGERS/SPECIFICATIONS
Metallurgical problems of the He-to-He heat exchanger for advanced HTR's, 4:38719
HEAT FLOW/MAPPING
The map of heat flow in Europe and its role in the preliminary evaluation of the sources of geothermal energy, 4:38521
HEAT FLOW/MAPS
Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790, 4:38514
HEAT OF VAPORIZATION
See VAPORIZATION HEAT
HEAT PIPES/FABRICATION
Ceramic heat pipes for high temperature heat removal, 4:39258 (LA-UR-79-332)
HEAT PIPES/PERFORMANCE TESTING
Ceramic heat pipes for high temperature heat removal, 4:39258 (LA-UR-79-332)
HEAT PUMPS
See also SOLAR-ASSISTED HEAT PUMPS
HEAT PUMPS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
HEAT PUMPS/DESIGN
Heat pump system with improved heat transfer (Patent), 4:39002
HEAT PUMPS/ECONOMICS
Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
National energy plan: energy conservation with heat pumps. Final report, 4:39013 (HIT-690)
HEAT PUMPS/EFFICIENCY
Combined heat pump system and ice making system (Patent), 4:39000
National energy plan: energy conservation with heat pumps. Final report, 4:39013 (HIT-690)
HEAT PUMPS/ENERGY CONSUMPTION
Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
HEAT PUMPS/HEAT RECOVERY
Energy-saving milk production. Using the heat of the milk for heating water, 4:39032
HEAT PUMPS/MATHEMATICAL MODELS
Heat pump modeling: a progress report, 4:38992 (CONF-790446-4)
HEAT PUMPS/PERFORMANCE
Heat pump modeling: a progress report, 4:38992 (CONF-790446-4)
HEAT RECOVERY EQUIPMENT/DESIGN
Run-around type energy recovery system (Patent), 4:39001
Waste energy recovery system (Patent), 4:38999
HEAT RECOVERY EQUIPMENT/FABRICATION
Ceramic heat pipes for high temperature heat removal, 4:39258 (LA-UR-79-332)
HEAT RECOVERY EQUIPMENT/PERFORMANCE TESTING
Ceramic heat pipes for high temperature heat removal, 4:39258 (LA-UR-79-332)
HEAT RESISTING ALLOYS/CORROSION
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N-78-28225)
HEAT RESISTING ALLOYS/EROSION
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N-78-28225)
HEAT RESISTING ALLOYS/MECHANICAL PROPERTIES
Material data for high temperature design, 4:39142
HEAT RESISTING ALLOYS/MEETINGS
Recent developments in high temperature design methods, 4:39144
HEAT STORAGE
See also LATENT HEAT STORAGE
SENSIBLE HEAT STORAGE
THERMAL ENERGY STORAGE EQUIPMENT
Solar energy storage and utilization (Patent), 4:38508
HEAT STORAGE/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
HEAT STORAGE/CHEMICAL COMPOSITION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
HEAT STORAGE/THERMAL DEGRADATION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
HEAT TRANSFER
See also HEAT FLOW
HEAT TRANSFER/COMPUTER CALCULATIONS
Solution of non-linear differential equations by discrete least squares, 4:40045
HEAT TRANSFER/NUMERICAL SOLUTION
Comparison of some characteristics of finite element and finite difference calculations of transient thermal problems, 4:39326 (SAND-78-8047)

HEAT TRANSFER FLUIDS/CHEMICAL COMPOSITION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
HEAT TRANSFER FLUIDS/THERMAL DEGRADATION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
HEAT TRANSMISSION
See HEAT TRANSFER
HEATING LOAD/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
HEATING SYSTEMS
See also SOLAR HEATING SYSTEMS
HEATING SYSTEMS/COMPARATIVE EVALUATIONS
Residential electric heating and cooling: total cost of service, 4:39003 (CONF-7809138-1)
HEATING SYSTEMS/DESIGN
Building heating system (Patent), 4:38997
Heating appliances (Patent), 4:38998
HEAVY ION ACCELERATORS
See also HHIRF
HEAVY ION ACCELERATORS/BEAM BUNCHERS
Control system for the Holifield Heavy Ion Research Facility beam buncher, 4:39443 (CONF-790327-9)
HEAVY ION ACCELERATORS/BEAM BUNCHING
Bunched beam neutralization, 4:39380 (BNL-25788)
HEAVY ION ACCELERATORS/BEAM NEUTRALIZATION
Bunched beam neutralization, 4:39380 (BNL-25788)
HEAVY ION REACTIONS
See also ARGON 40 REACTIONS
BORON 11 REACTIONS
CARBON 12 REACTIONS
NICKEL 64 REACTIONS
OXYGEN 16 REACTIONS
Large fragment production calculations in relativistic heavy-ion reactions (Abrasion-ablation model, cross sections, fireball and firestreak models), 4:39865 (LBL-8561)
HEAVY ION REACTIONS/ANGULAR MOMENTUM
Dynamical birth and thermal death of angular momentum in heavy ion reactions (Collective model, 600 MeV, cross sections, J), 4:39914 (LBL-8613)
HEAVY ION REACTIONS/FRAGMENTATION
Abrasion-ablation calculations of large fragment yields from relativistic heavy ion reactions, 4:39935
Giant E1 mode and its energy broadening from the charge distributions in heavy-ion reactions, 4:39928
HEAVY ION REACTIONS/FUSION REACTIONS
Role of the conservative potential and dissipation in heavy-ion fusion, 4:39932 (COO-3496-70)
HEAVY ION REACTIONS/GIANT RESONANCE
Giant E1 mode and its energy broadening from the charge distributions in heavy-ion reactions, 4:39928
HEAVY ION REACTIONS/WAVE FUNCTIONS
Polarizability of nuclear wave functions in heavy ion reactions (Adiabatic theory, two-center shell model, DWBA amplitude), 4:39937
HEAVY IONS/BEAM BUNCHING
Buncher development for ORIC injection, 4:39425 (LA-7445-C)
HEAVY IONS/ION SOURCES
Brookhaven terminal ion source, 4:39428 (LA-7445-C)
Operating experience with an 834 Hiconex sputter ion source, 4:39427 (LA-7445-C)
HEAVY IONS/ION-ATOM COLLISIONS
Theory of electron transfer and ionization, 4:39789 (CONF-790438-1)
HEAVY WATER MODERATED REACTORS
See also CANDU TYPE REACTORS
FR-2 REACTOR
SGHWR REACTOR
HEAVY WATER MODERATED REACTORS/REACTOR COOLING SYSTEMS
Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
HEAVY WATER PLANTS/CHEMICAL EFFLUENTS
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
HECTORITE
See MONTMORILLONITE
HELIOSTATS/MATHEMATICAL MODELS
Helios model for the optical behavior of reflecting solar concentrators, 4:38496 (SAND-76-0347)
HELIOSTATS/MECHANICAL PROPERTIES
Heliostat reflective surface substrate characterization, 4:38408 (PNL-2810)
HELIOSTATS/STRESS RELAXATION
Heliostat reflective surface substrate characterization, 4:38408 (PNL-2810)
HELIUM/CHARGED-PARTICLE TRANSPORT
Proton beam excited lasers, 4:39286 (CONF-771035-P2)
HELIUM/COLLISIONS
Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces (Mechanism, rainbow scattering, angular distribution), 4:39772 (LBL-7687)
Temperature dependence of alignment production in He I by beam-foil excitation, 4:39778
HELIUM/ENERGY-LEVEL TRANSITIONS
Temperature dependence of alignment production in He I by beam-foil excitation, 4:39778
HELIUM/ION-ATOM COLLISIONS
Many-electron aspects of molecular promotion in ion-atom collisions: Production of core-excited states of Li in Li^+-He collisions, 4:39798
HELIUM/PUMPING
Performance of vacuum components operating at 1×10^{-11} Torr, 4:39486
HELIUM 3 TARGET/ISOBARIC ANALOGS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
HELIUM 3 TARGET/NEUTRON REACTIONS
Summary documentation for ^{3}He (1 keV to 1 MeV), 4:39882 (LA-7663-MS)
HELIUM 3 TARGET/PION MINUS REACTIONS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
HELIUM 4 TARGET/NEUTRON REACTIONS
Summary documentation for ^{4}He (10^{-11} to 20 MeV), 4:39883 (LA-7663-MS)
HELIUM 6/ENERGY LEVELS
Theory and evaluation of nuclear cross sections: fusion reactions, 4:39884 (LA-7722-PR)
HELIUM COOLED REACTORS/DISTRICT HEATING
Heat extraction from nuclear power plants, 4:38714 (INIS-mf-4376)
HELIUM HYDRIDES/ELECTRONIC STRUCTURE
Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977-October 31, 1978 (Summaries of research activities at Brown Univ.), 4:39931 (COO-3235-85)
HEMOGLOBIN/BIOCHEMICAL REACTION KINETICS
Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
HEMOGLOBIN/BIOSYNTHESIS
Relationship of hemoglobin synthesis to erythroid colony and burst formation, 4:39639
HEPARIN/BIOCHEMICAL REACTION KINETICS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
HEPTANE/BOILING POINTS
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
HEPTANE/VAPORIZATION HEAT
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
HETEROZYGOTES
See HYBRIDIZATION
HEXAGONAL LATTICES/CRACKS
Elastic energy of slit cracks in hexagonal crystals, 4:39130
HEXAGONAL LATTICES/ELASTICITY
Elastic energy of slit cracks in hexagonal crystals, 4:39130
HEXANE/BOILING POINTS
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
HEXANE/VAPORIZATION HEAT
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
HFIR REACTOR/REACTOR CONTROL SYSTEMS
Malfunction detection of nuclear reactor by dynamic data system methodology, 4:38755
HHIRF
(Holifield Heavy Ion Research Facility.)
HHIRF/ACCELERATOR FACILITIES
Holifield Heavy Ion Research Facility. Phase II, 4:39441 (CONF-790327-3)
HHIRF/CONSTRUCTION
Progress on the Oak Ridge tandem, 4:39370 (LA-7445-C)
HIGGS MODEL/PHASE TRANSFORMATIONS
Phase transitions in the Abelian Higgs model, 4:39840

HIGGS MODEL/SCALAR FIELDS
Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model, 4:39869
HIGH BTU GAS/BIOSYNTHESIS
Management of swine manure for the recovery of protein and biogas. Final report, 4:38318 (PB-286722)
HIGH ENERGY PHYSICS/RADIATION DETECTORS
Detectors; relation of detectors to proton-anti proton machines, 4:39455 (LBL-7574)
HIGH ENERGY PHYSICS/RESEARCH PROGRAMS
Experimental physics. Annual report, July 1, 1978-March 1, 1979 (Summaries of research activities at Rockefeller Univ.), 4:39814 (COO-2232A-78)
HIGH EXPLOSIVES
See CHEMICAL EXPLOSIVES
HIGH FLUX ISOTOPE REACTOR
See HFIR REACTOR
HIGH-LEVEL RADIOACTIVE WASTES/COMPRESSION STRENGTH
Processes for immobilization of high-level solid wastes by glass and ceramic matrices, 4:38250 (CONF-790420-9)
HIGH-LEVEL RADIOACTIVE WASTES/POROSITY
Processes for immobilization of high-level solid wastes by glass and ceramic matrices, 4:38250 (CONF-790420-9)
HIGH-TEMPERATURE GAS-COOLED REACTOR
See HTGR TYPE REACTORS
HIGHWAYS
See ROADS
HISTOLOGICAL TECHNIQUES/COMPARATIVE EVALUATIONS
Improved histochemical methods for the examination of plastic-embedded human marrow, 4:39650 (UR-3490-1553)
HOLIFIELD HEAVY ION RESEARCH FACILITY
See HHIRF
HOLMIUM 165/ENERGY LEVELS
Levels in ^{165}Ho populated in the ^{166}Er(t(pol),α) reaction (Polarization, 17 MeV, analyzing powers, j, Nilson-model assignments), 4:39913
HOMOZYGOTES
See HYBRIDIZATION
HONEYCOMB STRUCTURES/DESIGN
Studies on methods of reducing heat losses from flat plate solar collectors. Progress report, 1 August 1974-31 January 1976, 4:38495 (PB-283783)
HORDEUM
See BARLEY
HORIZONTAL DIVESTITURE/ECONOMIC IMPACT
Horizontal divestiture of energy companies, 4:38925
HORIZONTAL DIVESTITURE/RECOMMENDATIONS
Horizontal divestiture of energy companies, 4:38925
HOSPITALS/ENERGY CONSERVATION
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
HOSPITALS/RETROFITTING
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
HOT SPRINGS/INFRARED SURVEYS
Geothermal survey with infrared radiation thermometer and thermister thermometer- Namekawa Spa and Ubayu Spa, 4:38522
HOT-DRY-ROCK SYSTEMS/FRACTURING
Future of hot dry rock geothermal energy systems, 4:38548 (LA-UR-79-683)
HOT-DRY-ROCK SYSTEMS/HEAT EXTRACTION
Federal hot dry rock geothermal energy development program: an overview, 4:38547 (LA-UR-79-670)
Future of hot dry rock geothermal energy systems, 4:38548 (LA-UR-79-683)
HOT-DRY-ROCK SYSTEMS/HYDRAULIC FRACTURING
Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1977-August 31, 1978, 4:38520 (COO-2534-4)
HOT-DRY-ROCK SYSTEMS/RESEARCH PROGRAMS
Federal hot dry rock geothermal energy development program: an overview, 4:38547 (LA-UR-79-670)
HOT-DRY-ROCK SYSTEMS/THERMODYNAMIC PROPERTIES
Thermal properties of rocks and heat extraction from hot dry rocks. I, 4:38553
HOUSES/AIR POLLUTION
Postprandial changes in the exhalation of radon from the environment, 4:39579 (ANL-78-65(Pt.2))
HOUSES/ENERGY CONSERVATION
Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings, 4:38470 (LBL-7811)
HOUSES/PASSIVE SOLAR HEATING SYSTEMS
Direct gain passive design: delap residence (Delap residence), 4:38433 (CONF-780337-P2)
Earth-integrated direct gain residence using concrete cored slab, 4:38469 (IS-M-192)
Gayland B. Witherspoon residence, Central, S.C., 4:38443 (CONF-780337-P2)
Harrison residence: Placitas, New Mexico, 4:38441 (CONF-780337-P2)
House at Crooked Creek. Direct gain passive solar design in an extreme climate, 4:38444 (CONF-780337-P2)
Hybrid solar system in Los Alamos, New Mexico, 4:38439 (CONF-780337-P2)
Kelbaugh House: recent performance, 4:38450 (CONF-780337-P2)
Knowing and loving, and never knowing: two houses, 4:38442 (CONF-780337-P2)
Levine house, 4:38437 (CONF-780337-P2)
Lindeberg residence: a DOE funded hybrid solar house, 4:38438 (CONF-780337-P2)
Lumsdaine solar house, 4:38440 (CONF-780337-P2)
Passive heated residences, 4:38436 (CONF-780337-P2)
Passive solar heated house and greenhouse on Cape Cod, description and performance, 4:38447 (CONF-780337-P2)
Prediction of performance of a minimal storage passive solar house: the Crosley home, 4:38452 (CONF-780337-P3)
Quantitative method for the design of buildings with comfortable microclimates by passive control of solar effects, 4:38453 (CONF-780337-P3)
Soldyne house, 4:38434 (CONF-780337-P2)
HOUSES/SOLAR SPACE HEATING
Farmstead heated with solar energy, 4:38484
Greenbelt community project: solar energy retrofit for a multi-family dwelling, 4:38474 (N-78-31539)
HOUSES/WIND TURBINES
Farmstead heated with solar energy, 4:38484
HTGR TYPE REACTORS
See also VRAIN REACTOR
ADAM I - methanation pilot plant, 4:38716 (Juel-1433)
HTGR TYPE REACTORS/COATED FUEL PARTICLES
Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures, 4:38809 (Juel-1490)
HTGR TYPE REACTORS/FISSION PRODUCT RELEASE
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
HTGR TYPE REACTORS/FUEL ELEMENT FAILURE
Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures, 4:38809 (Juel-1490)
HTGR TYPE REACTORS/FUEL ELEMENTS
Qualification of HTGR fuel by rig development and irradiation testing at BR2 Mol, 4:38640 (INIS-mf-4426)
HTGR TYPE REACTORS/HEAT EXCHANGERS
Metallurgical problems of the He-to-He heat exchanger for advanced HTR's, 4:38719
HTGR TYPE REACTORS/PRESSURE VESSELS
Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems, 4:38642 (ORNL/TM-6478)
HTGR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Analytical study of solids-gas two phase flow, 4:38689 (UTNL-R-0046)
HTGR TYPE REACTORS/REACTOR ACCIDENTS
Investigations of the behaviour of coated fuel particles and spherical fuel elements at accident temperatures, 4:38809 (Juel-1490)
HTGR TYPE REACTORS/REACTOR CORES
One-fifth scale full-array test report. Final report, 4:38799 (GA-A-14546)
HTGR TYPE REACTORS/REACTOR SAFETY
High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research quarterly progress report, October 1-December 31, 1978, 4:38819 (NUREG/CR-0716)
Safety analyses for high-temperature reactors, 4:38789 (AED-Conf-78-023-004)
HTGR TYPE REACTORS/SPECIFICATIONS
High-temperature reactor, 4:38715 (INIS-mf-4494)
HUMAN CELLS
See ANIMAL CELLS
HUMAN POPULATIONS/ENVIRONMENTAL EXPOSURE PATHWAY
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
HUMAN POPULATIONS/RADIATION PROTECTION
Radiological emergency response planning: Handbook for Federal Assistance to State and Local Governments, 4:39662 (NUREG-0093(Rev.1))

HUMIDITY/DATA ACQUISITION
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
HUMIDITY/DATA ANALYSIS
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
HVDC SYSTEMS/CIRCUIT BREAKERS
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978-December 31, 1978, 4:38619 (COO-5014-3)
Fundamental techniques for gas-insulated apparatus, 4:38618
HVDC SYSTEMS/ECONOMICS
High voltage dc for resource development, 4:38620
HVDC SYSTEMS/RELIABILITY
High voltage dc for resource development, 4:38620
HVDC SYSTEMS/RESEARCH PROGRAMS
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978-December 31, 1978, 4:38619 (COO-5014-3)
DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977-September 30, 1978, 4:38622 (LA-7707-PR)
HVDC SYSTEMS/SUPERCONDUCTING CABLES
DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977-September 30, 1978, 4:38622 (LA-7707-PR)
HVDC SYSTEMS/SWITCHES
Fundamental techniques for gas-insulated apparatus, 4:38618
HVDC SYSTEMS/TECHNOLOGY ASSESSMENT
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1978-December 31, 1978, 4:38619 (COO-5014-3)
HYBRID ELECTRIC-POWERED VEHICLES/CONTROL SYSTEMS
The application of optimal control theory to hybrid electric transit systems. Master's thesis, 4:39076 (AD-A-059365)
HYBRID ELECTRIC-POWERED VEHICLES/PERFORMANCE
The application of optimal control theory to hybrid electric transit systems. Master's thesis, 4:39076 (AD-A-059365)
HYBRID REACTORS/COOLANTS
Nuclear performance of molten salt fusion-fission symbiotic systems for catalyzed DD and DT reactors, 4:40010 (ORNL/TM-6560)
HYBRIDIZATION/ASYMMETRY
Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast, 4:39659 (UR-3490-1568)
HYBRIDS
See HYBRIDIZATION
HYDRAULIC EQUIPMENT/VALVES
Hydraulic mine prop (Patent), 4:38107
HYDRAULIC FRACTURING
Some results from continuum mechanics analyses of the hydraulic fracturing process, 4:38182 (UCRL-81707)
HYDRAULIC FRACTURING/STRESS ANALYSIS
LLL gas stimulation program. Quarterly progress report, October-December 1978, 4:38181 (UCRL-50036-78-4)
HYDRAULIC TURBINES/TECHNOLOGY ASSESSMENT
Bulb units for low-head hydroelectric generation, 4:38336
Ossberger cross-flow turbine, 4:38335
Straflo turbine, 4:38334
Tube turbines, 4:38337
HYDRIDES/THERMODYNAMIC PROPERTIES
Stability of the lanthanide hydrides, 4:39221 (LA-7602-MS)
HYDROBROMIC ACID/ROTATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
HYDROBROMIC ACID/VIBRATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
HYDROCARBON FUEL CELLS/ANODES
Improved anodes for liquid hydrocarbon fuel cell. Research and development technical report, 4:38988 (AD-A-058456)
HYDROCARBONS
See also ALKANES
ALKENES
BENZOPYRENE
TETRALIN
TOLUENE
HYDROCARBONS/BIODEGRADATION
Transposition of plasmid DNA segments specifying hydrocarbon degradation and their expression in various microorganisms, 4:39644
HYDROCARBONS/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
HYDROCARBONS/CHEMICAL REACTION YIELD
Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). First quarter report, April 1-June 30, 1978, 4:38075 (FE-2307-38)
HYDROCARBONS/ELECTRONIC STRUCTURE
Chemical information in Auger spectroscopy, 4:39241 (LBL-8975)
HYDROCARBONS/FISCHER-TROPSCH SYNTHESIS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
HYDROCARBONS/INVENTORIES
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)
HYDROCARBONS/QUANTITATIVE CHEMICAL ANALYSIS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)
HYDROCARBONS/SYNTHESIS
Catalytic synthesis of hydrocarbons, 4:38316 (LBL-8975)
Characterization of $CO + H_2$ catalysts for production of light hydrocarbons, 4:38315 (LBL-8975)
Method for producing hydrocarbons from igneous sources (Patent; using subterranean heat), 4:38317
HYDROCHLORIC ACID/ROTATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
HYDROCHLORIC ACID/VIBRATIONAL STATES
Vibrational energy transfer in selectively excited diatomic molecules (Relaxation rates, self-relaxation, upper limits), 4:39784 (LBL-8208)
HYDRODYNAMICS
See also MAGNETOHYDRODYNAMICS
HYDRODYNAMICS/COMPUTER CALCULATIONS
Anisotropic constitutive equation for use in finite difference wave propagation calculations (Incorporation into TOODY code), 4:39810 (SAND-79-0382)
HYDRODYNAMICS/THREE-DIMENSIONAL CALCULATIONS
Variational approach to the construction of difference systems for hydrodynamic equations in spherical coordinates, 4:39809 (UCRL-Trans-11468)
HYDROELECTRIC POWER/ECONOMIC ANALYSIS
Economic comparison of five hydroelectric projects in Idaho, 4:38345
HYDROELECTRIC POWER/MARKET
Marketing low-head hydroelectric power, 4:38346
HYDROELECTRIC POWER/MEETINGS
Low-head hydro: an examination of an alternative energy source (Seminar at Univ. of Idaho, June 6-7, 1978; 31 papers), 4:38325
HYDROELECTRIC POWER PLANTS
See also LOW-HEAD HYDROELECTRIC POWER PLANTS
PUMPED STORAGE POWER PLANTS
HYDROELECTRIC POWER PLANTS/BUDGETS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
HYDROELECTRIC POWER PLANTS/DECISION MAKING
Hydro choice: high, low, or no, 4:38327
HYDROELECTRIC POWER PLANTS/FINANCIAL INCENTIVES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
HYDROELECTRIC POWER PLANTS/OPERATION
Optimum hydrothermal electric energy system scheduling: challenges and opportunities in research and development in Canada, 4:38572
HYDROELECTRIC POWER PLANTS/WASTE HEAT
Hydrothermal modeling techniques associated with waste heat disposal, 4:39623
HYDROELECTRIC POWER PLANTS/WATER RESERVOIRS
Operations of the national weather service, 4:38332 (PB-286739)
HYDROELECTRIC POWER PLANTS/WATER RESOURCES
Operations of the national weather service, 4:38332 (PB-286739)
HYDROELECTRICITY
See HYDROELECTRIC POWER

HYDROFLUORIC ACID/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
HYDROGEN/ADSORPTION
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
HYDROGEN/CHEMICAL REACTIONS
Catalytic hydrogenation process, 4:39246
Experimental measurement of the rate of the reaction O(3p) + H2(v = 0) yields OH(v = 0) + H at T = 296°K. Interim report, 4:39218 (AD-A-059447)
HYDROGEN/CHEMISORPTION
Theoretical studies of nickel clusters and chemisorption of hydrogen, 4:39151
Theoretical studies of chemisorption on transition metal surfaces: interaction of hydrogen with titanium, 4:39229 (LBL-8975)
HYDROGEN/COLLISIONS
Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces (Mechanism, rainbow scattering, angular distribution), 4:39772 (LBL-7687)
HYDROGEN/COMBUSTION KINETICS
Analysis of turbulent free jet hydrogen-air diffusion flames with finite chemical reaction rates. Final report, 4:38311 (N-78-30551)
HYDROGEN/DIFFUSION
Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM-2600(TR))
HYDROGEN/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
HYDROGEN/FLAMES
Analysis of turbulent free jet hydrogen-air diffusion flames with finite chemical reaction rates. Final report, 4:38311 (N-78-30551)
HYDROGEN/ION-ATOM COLLISIONS
Theory of electron transfer and ionization, 4:39789 (CONF-790438-1)
HYDROGEN/OXIDATION
Catalytic reactions on well characterized surfaces by ac techniques, 4:39223 (LBL-8975)
HYDROGEN/PUMPING
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
HYDROGEN 1 MINUS BEAMS/BEAM BENDING MAGNETS
Study of a 90° bending magnet for H^- beams, 4:39405 (LA-UR-79-710)
HYDROGEN 1 TARGET/ELECTRON REACTIONS
Parity non-conservation in inelastic electron scattering (Asymmetries), 4:39870
HYDROGEN 1 TARGET/NEUTRON REACTIONS
Summary documentation for ^1H (10^{-5} eV to 20 MeV), 4:39881 (LA-7663-MS)
HYDROGEN 1 TARGET/PROTON REACTIONS
Differential cross section for proton-proton bremsstrahlung at 1.38 GeV/c, 4:39827
HYDROGEN 2
See DEUTERIUM
HYDROGEN 3
See TRITIUM
HYDROGEN BROMIDES
See HYDROBROMIC ACID
HYDROGEN CHLORIDES
See HYDROCHLORIC ACID
HYDROGEN FLUORIDES
See HYDROFLUORIC ACID
HYDROGEN FUEL CELLS/DESIGN
Overchargeable sealed metal oxide/lanthanum nickel hydride battery (Patent), 4:38986
HYDROGEN FUELS/BIBLIOGRAPHIES
Hydrogen energy: a bibliography with abstracts, 1978. Quarterly reports, 4:38307 (NTISUB/D-023)
HYDROGEN IONS 1 PLUS/AEROSOL MONITORING
Role of ammonia in the chemistry of atmospheric aerosols, 4:39543 (IVL-B-449)
HYDROGEN IONS 1 PLUS/COLLISIONS
H^+ and D^+ sputtering of thin tantalum films in the energy range of 0.6 to 15 keV, 4:39148
HYDROGEN IONS 2 PLUS/MOLECULAR STRUCTURE
Diatomic-molecule vibrational potentials. II. New representationsa), 4:39785
HYDROGEN PRODUCTION
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report (By steam gasification and steam reduction with metals), 4:38077 (FE-2893-16)
One- and two-dimensional heating analyses of fusion synfuel blankets, 4:40005 (BNL-NUREG-25635)
HYDROGEN PRODUCTION/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
HYDROGEN PRODUCTION/BIOPHOTOLYSIS
Photobiological production of hydrogen: a solar energy conversion option, 4:38309 (SERI/TR-33-122)
Recent developments in hydrogen production by microalgae, 4:38310
Solar energy conversion to hydrogen by algae and bacteria, 4:38308 (CONF-780161-1)
HYDROGEN PRODUCTION/BIOSYNTHESIS
Assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation, 4:38324 (N-78-30798)
HYDROGEN PRODUCTION/CHEMICAL REACTIONS
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)
HYDROGEN PRODUCTION/RESEARCH PROGRAMS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
HYDROGEN SULFATES
See SULFURIC ACID
HYDROGEN SULFIDES/CORROSIVE EFFECTS
Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978-31 May 1979, 4:39091 (COO-2960-3)
Program to discover materials suitable for service under hostile conditions obtaining in equipment for the gasification of coal and other solid fuels. Quarterly progress report, April 1, 1978-June 30, 1978, 4:38053 (FE-1784-42)
HYDROGEN SULFIDES/ENVIRONMENTAL TRANSPORT
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
HYDROGEN SULFIDES/EVAPORATION
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
HYDROGEN SULFIDES/GAS CHROMATOGRAPHY
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
HYDROGEN SULFIDES/MONITORING
Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976-February 1977, 4:39563 (PB-285059)
HYDROGEN SULFIDES/OXIDATION
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
HYDROGEN SULFIDES/TOXICITY
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
HYDROGEN-BASED ECONOMY/BIBLIOGRAPHIES
Hydrogen energy: a bibliography with abstracts, 1978. Quarterly reports, 4:38307 (NTISUB/D-023)
HYDROLOGY/COMPUTER CALCULATIONS
Finite element method for subsurface hydrology using a mixed explicit-implicit scheme, 4:39708
HYDROLOGY/MATHEMATICAL MODELS
Burial ground technology, 4:39603 (ORNL-5508)
HYDROTHERMAL SYSTEMS
See also GEOTHERMAL SYSTEMS
HYDROTHERMAL SYSTEMS/MAPS
Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790, 4:38514
Geothermal energy in Alaska and Hawaii. Map 2 of U.S. Geological Survey Circular 790, 4:38515
HYDROTHERMAL SYSTEMS/WELL LOGGING
Geothermal well log interpretation midterm report, 4:38524 (LA-7693-MS)
HYDROXYBENZENE
See PHENOL
HYDROXYL RADICALS/CHEMICAL REACTION KINETICS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
HYDROXYTOLUENES
See CRESOLS
HYPERFRAGMENTS
See HYPERNUCLEI
HYPERNUCLEI/BOUND STATE
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)

I

I-BEAM TYPE REACTORS/RESEARCH PROGRAMS
Lawrence Livermore Laboratory heavy ion fusion program, 4:40016 (UCRL-82120)
ICE/CONTROL
Research on control technology for ice fog from mobile sources, 4:39079 (PB-285611)
ICE/PRODUCTION
Combined heat pump system and ice making system (Patent), 4:39000
ICELAND/GEOTHERMAL POWER PLANTS
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO-4051-38)
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
IDAHO/GEOLOGY
Uranium potential and geology of the Challis Volcanics of the Basin Creek-Yankee Fork Area, Custer County, Idaho. Final report, 4:38206 (GJBX-33(79))
IDAHO/HYDROELECTRIC POWER
Economic comparison of five hydroelectric projects in Idaho, 4:38345
IDAHO/LOW-HEAD HYDROELECTRIC POWER PLANTS
What Idaho Power has learned, 4:38340
IDAHO/RESOURCE POTENTIAL
Uranium potential and geology of the Challis Volcanics of the Basin Creek-Yankee Fork Area, Custer County, Idaho. Final report, 4:38206 (GJBX-33(79))
IDAHO CHEMICAL PROCESSING PLANT/SAFEGUARDS
Applying new safeguards technology to existing nuclear facilities, 4:38289 (CONF-790430-2)TI07IDAHO NATIONAL ENGINEERING TI08IDAHO NATIONAL ENGINEERING
IDAHO NATIONAL ENGINEERING LABORATORY/ RADIOACTIVE WASTE MANAGEMENT
Evaluations of alternatives for management of INEL transuranic waste, 4:38248 (CONF-790602-30)
ILLINOIS/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ILLINOIS/RADIOACTIVE MATERIALS
Transportation of radioactive material in Illinois: June 6, 1977-June 6, 1978, 4:38245 (NUREG/CR-0756)
ILLINOIS/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ILLINOIS/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
ILLITE/SORPTIVE PROPERTIES
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
IMPERMEABLE DRY ROCK
See HOT-DRY-ROCK SYSTEMS
IMPINGEMENT/BIOLOGICAL EFFECTS
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
IMPURITIES/TRAPPING
Hydrogen isotope trapping in materials exposed in PLT, 4:40006 (PPPL-1537)
IN CORE INSTRUMENTS
(See also specific instruments.)
See also REACTOR INSTRUMENTATION
Detectors for in-reactor measurement of energy release (Book; in Russian), 4:39491
IN PILE LOOPS/NEUTRON FLUX
Neutronic studies for the design of irradiation devices, 4:38722 (INIS-mf-4426)
INCOLOY 800/MATERIALS TESTING
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
INCOLOY ALLOYS
See also INCOLOY 800
High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat, 4:39143
INCOLOY ALLOYS/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
INCONEL 671/MATERIALS TESTING
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
INCONEL ALLOYS/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
INDIANA/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
INDIANA/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
INDIANA/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
INDIUM/ADSORPTION
AES study of the adsorption of O_2, CO, CO_2, and H_2O on indium, 4:39152
INDIUM/SPUTTERING
AES study of the adsorption of O_2, CO, CO_2, and H_2O on indium, 4:39152
INDIUM PHOSPHIDES/PHOTOELECTRON SPECTROSCOPY
Photoemission study of Al/III-V interfaces, 4:39953
INDUSTRIAL MEDICINE
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
INDUSTRIAL PLANTS
See also COAL GASIFICATION PLANTS
COAL LIQUEFACTION PLANTS
COAL PREPARATION PLANTS
FEED MATERIALS PLANTS
GASEOUS DIFFUSION PLANTS
ISOTOPE SEPARATION PLANTS
OIL SHALE PROCESSING PLANTS
PETROCHEMICAL PLANTS
INDUSTRIAL PLANTS/ENERGY CONSERVATION
Department of Energy workshop on industrial energy conservation reporting, Washington, DC, November 6-7, 1978, 4:39029 (RLO-1830-T1)
INDUSTRIAL PLANTS/ENERGY MANAGEMENT
Energy monitor and control system (Patent), 4:39015
INDUSTRIAL PLANTS/GASEOUS WASTES
Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas (Patent), 4:39355
INDUSTRIAL PLANTS/SOLAR AIR CONDITIONING
A socio-economic and marketing study for a Puerto Rico Economic Development Administration (fomento) solar cooled factory in Puerto Rico. Final report, 4:38479 (PB-284138)
INDUSTRIAL PLANTS/WATER REQUIREMENTS
Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976-30 September 1977, 4:38888 (PB-286038)
INDUSTRIAL RADIOGRAPHY
See also GAMMA RADIOGRAPHY
X-RAY RADIOGRAPHY
INDUSTRIAL RADIOGRAPHY/RADIATION PROTECTION
Public meeting on radiation safety for industrial radiographerss: remarks, questions and answers at five NRC regional meetings, 4:39663 (NUREG-0495)
INDUSTRIAL WASTES/DENITRIFICATION
Biological denitrification of industrial strength nitrate wastes, 4:39049 (Y/DA-8220)
INDUSTRIAL WASTES/ENERGY RECOVERY
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INDUSTRIAL WASTES/HAZARDOUS MATERIALS
Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB-285072)
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A study of the feasibility of utilizing solid wastes for building materials. phase iii and iv summary reports. Final report, September 1975-March 1978, 4:39046 (PB-285437)
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Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
INDUSTRIALIZED COUNTRIES
See DEVELOPED COUNTRIES
INDUSTRY
See also CHEMICAL INDUSTRY
COAL INDUSTRY
ELECTRIC POWER INDUSTRY
FERTILIZER INDUSTRY
MEAT INDUSTRY
METAL INDUSTRY
MINERAL INDUSTRY
NUCLEAR INDUSTRY
OIL SHALE INDUSTRY
PAPER INDUSTRY

PETROLEUM INDUSTRY
SOLAR INDUSTRY
SYNTHETIC FUELS INDUSTRY
TEXTILE INDUSTRY

INDUSTRY/ENERGY CONSERVATION
Buildings energy management program workshop design. Final report, 4:39012 (CONS-8630-T1)

INDUSTRY/ENERGY MANAGEMENT
Buildings energy management program workshop design. Final report, 4:39012 (CONS-8630-T1)
Proposed industrial energy data base for technical evaluation of alternative energy systems, 4:39028 (CONF-781244-1)

INDUSTRY/ENERGY SOURCES
Proposed industrial energy data base for technical evaluation of alternative energy systems, 4:39028 (CONF-781244-1)

INDUSTRY/HORIZONTAL DIVESTITURE
Horizontal divestiture of energy companies, 4:38925

INFORMATION SYSTEMS/DESIGN
Rocky Flats experience with SDM/70, 4:40041 (RFP-2902)

INFORMATION THEORY/SET THEORY
Study of set-theoretic information processing, 4:38859 (UCRL-13970)

INHALATION EXPOSURE CHAMBERS
See EXPOSURE CHAMBERS

INHOMOGENEOUS PLASMA/PLASMA WAVES
A new treatment of localized modes in inhomogeneous Vlasov plasma, 4:39996 (N-78-27915)

INITIAL RESERVOIR PRESSURE
See RESERVOIR PRESSURE

INPUT-OUTPUT ANALYSIS
See ENERGY ANALYSIS

INSECTICIDES
See also KEPONE

INSECTICIDES/ECOLOGICAL CONCENTRATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)

INSECTICIDES/ENVIRONMENTAL EXPOSURE PATHWAY
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)

INSECTS/TEMPERATURE EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)

IN-SITU COMBUSTION/CONTROL
Process and device for controlling in situ combustion (Patent), 4:38152

IN-SITU COMBUSTION/DEMONSTRATION PROGRAMS
Bodcau In Situ Combustion Project. Second annual report, July 1, 1977-June 30, 1978, 4:38144 (SAN-1189-3)

IN-SITU GASIFICATION
Economics of gasoline production from underground coal gasification via Mobil-M process, 4:38047 (CONF-790405-12)

IN-SITU GASIFICATION/CATALYSTS
Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals (Patent), 4:38070

IN-SITU GASIFICATION/PROCESS CONTROL
Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals (Patent), 4:38070

IN-SITU GASIFICATION/RESEARCH PROGRAMS
In-situ gasification of coal. Second report on the present and future programme of the U.S. Department of Energy, 4:38062 (FE-2765-T1)

IN-SITU RETORTING/MAPPING
Use of electrical geophysical techniques to map and monitor in situ oil shale recovery processes, 4:38192 (SAND-79-0746C)

IN-SITU RETORTING/MONITORING
Use of electrical geophysical techniques to map and monitor in situ oil shale recovery processes, 4:38192 (SAND-79-0746C)

IN-SITU RETORTING/PROCESS CONTROL
Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals (Patent), 4:38070

INSOLATION/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)

INSOLATION/CALCULATION METHODS
Estimation of atmospheric radiation for clear and cloudy skies, 4:38357 (CONF-780337-P3)

INSOLATION/SEASONAL VARIATIONS
Solar resource: motion and amplitude, 4:38356 (CONF-780337-P2)

INSTANTONS/MULTIPLE SCATTERING
Higher-order instanton effects, 4:39876

INSTRUMENTS (MEASURING)
See MEASURING INSTRUMENTS

INSULATION (THERMAL)
See THERMAL INSULATION

INTEGRATED CIRCUITS/DESIGN
Development of integrated thermionic circuits for geothermal high-temperature applications, 4:38525 (LA-UR-79-723)

INTEGRATED CIRCUITS/ELECTRIC CONDUCTORS
Method for preparing a thick film conductor (Patent), 4:39342

INTEGRATED CIRCUITS/FABRICATION
Deposition of aluminum-copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX-613-2173)

INTEGRATED CIRCUITS/PHYSICAL RADIATION EFFECTS
Technology assessment and radiation effects characterization of Integrated Injection Logic. Final report, July-September 1976, 4:39500 (AD-A-058360)

INTEGRATED UTILITY SYSTEMS
See TOTAL ENERGY SYSTEMS

INTERFEROMETERS
See also FABRY-PEROT INTERFEROMETER

INTERFEROMETERS/DESIGN
Microinterferometer transducer, 4:39510 (Y/DA-7109)

INTERMEDIATE BTU GAS/SYNTHESIS
Conversion of forest residues to a methane-rich gas, 4:38322

INTERNAL COMBUSTION ENGINES
See also DIESEL ENGINES
ROTARY ENGINES
STRATIFIED CHARGE ENGINES

INTERNAL COMBUSTION ENGINES/AUTOMOTIVE FUELS
Automotive technology status and projections. Volume 1. Executive summary, 4:39054 (N-78-31428)

INTERNAL COMBUSTION ENGINES/CATALYTIC CONVERTERS
Elastic mounting for a catalytic converter in an internal combustion engine (Patent), 4:39082

INTERNAL COMBUSTION ENGINES/EFFICIENCY
Improved engine performance through heat transfer control. Final report, 1 June 1976-30 June 1978, 4:38990 (AD-A-058637)

INTERNAL COMBUSTION ENGINES/EXHAUST GASES
Automotive technology status and projections. Volume 1. Executive summary, 4:39054 (N-78-31428)
Feedback emission control for internal combustion engines with variable reference compensation for change with time in performance of exhaust composition sensor (Patent), 4:39060
Investigation of turbo-dyne energy chamber (G:R:Valve trademark) - an air bleed device, 4:39057 (PB-285381)
Performance characteristics of automotive engines in the United States. First series - Report No. 15. 1975 Dodge Colt 98 CID (1.6 liters), 2v. Interim report, August 1977, 4:39065 (PB-286075)
Performance characteristics of automotive engines in the United States. Second series - Report No. 5. 1977 Ford 140 CID (2.3 liters), 2v. Interim report, November 1977, 4:39066 (PB-286076)
Performance characteristics of automotive engines in the United States. Third series - Report No. 1. 1977 Volvo 130 CID (2.1 liters), f. i. Interim report, November 1977, 4:39067 (PB-286077)
Research on control technology for ice fog from mobile sources, 4:39079 (PB-285611)

INTERNAL COMBUSTION ENGINES/EXHAUST RECIRCULATION SYSTEMS
Engine exhaust gas recirculation system with periodic recalibration of exhaust back pressure reference (Patent), 4:39084
Exhaust gas recirculation apparatus for an internal combustion engine (Patent), 4:39055
Exhaust gas purification system (Patent), 4:39083
Exhaust gas recirculation system (Patent), 4:39085

INTERNAL COMBUSTION ENGINES/FUEL CONSUMPTION
Fuel consumption measuring device (Patent), 4:39061

INTERNAL COMBUSTION ENGINES/FUEL ECONOMY
Automotive technology status and projections. Volume 1. Executive summary, 4:39054 (N-78-31428)
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
Investigation of turbo-dyne energy chamber (G:R:Valve trademark) - an air bleed device, 4:39057 (PB-285381)
Performance characteristics of automotive engines in the United States. First series - Report No. 15. 1975 Dodge Colt 98 CID (1.6 liters), 2v. Interim report, August 1977, 4:39065 (PB-286075)
Performance characteristics of automotive engines in the United States. Second series - Report No. 5. 1977 Ford 140 CID (2.3 liters), 2v. Interim report, November 1977, 4:39066 (PB-286076)
Performance characteristics of automotive engines in the United States. Third series - Report No. 1. 1977 Volvo 130 CID (2.1 liters), f. i. Interim report, November 1977, 4:39067 (PB-286077)

INTERNAL COMBUSTION ENGINES/FUEL INJECTION SYSTEMS
Electric fuel injection valve (Patent), 4:39068
Fuel injection system (Patent), 4:39062
Fuel-oil mixing apparatus for internal-combustion engines (Patent), 4:39069
Hot fuel gas generator (Patent), 4:39058

INTERNAL COMBUSTION ENGINES/FUEL-AIR RATIO
Feedback emission control for internal combustion engines with variable reference compensation for change with time in performance of exhaust composition sensor (Patent), 4:39060
INTERNAL COMBUSTION ENGINES/PERFORMANCE TESTING
Performance characteristics of automotive engines in the United States. First series - Report No. 15. 1975 Dodge Colt 98 CID (1.6 liters), 2v. Interim report, August 1977, 4:39065 (PB-286075)
Performance characteristics of automotive engines in the United States. Second series - Report No. 5. 1977 Ford 140 CID (2.3 liters), 2v. Interim report, November 1977, 4:39066 (PB-286076)
Performance characteristics of automotive engines in the United States. Third series - Report No. 1. 1977 Volvo 130 CID (2.1 liters), f. i. Interim report, November 1977, 4:39067 (PB-286077)
INTERNAL COMBUSTION ENGINES/POLLUTION CONTROL EQUIPMENT
Device for controlling the composition of the exhaust gases from a heat engine (Patent), 4:39080
INTERNAL COMBUSTION ENGINES/SUPERCHARGERS
Turbocharger lubrication and exhaust system (Patent), 4:39059
INTERNAL COMBUSTION ENGINES/TECHNOLOGY ASSESSMENT
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
INTERNAL COMBUSTION ENGINES/WASTE HEAT
Apparatus for hot gas heat transfer particularly for paper drying (Patent), 4:39042
INTERNATIONAL ENERGY AGENCY/ECONOMIC POLICY
Courage for a market economy energy policy, 4:39249
INTERNATIONAL ENERGY AGENCY/ENERGY POLICY
Courage for a market economy energy policy, 4:39249
INTERPLANETARY MAGNETIC FIELDS/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
INTERPLANETARY SPACE/MEETINGS
Space and energy (XXVI international astronautical), 4:38354
IODINE/RADIOACTIVE WASTE DISPOSAL
Disposal of radioactive iodine in space, 4:38263 (N-78-31740)
IODINE/RECOVERY
Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report, 4:38243 (IDO-1540-T1)
IODINE 123/ISOTOPE PRODUCTION
Targets for producing high purity I-123 (Patent), 4:39465
IODINE 125/ADSORPTION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
IODINE 125/BIOLOGICAL ACCUMULATION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
IODINE 125/ENVIRONMENTAL TRANSPORT
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
IODINE 125/ROOT ABSORPTION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
IODINE 129/RADIOACTIVE WASTE DISPOSAL
Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976, 4:38251 (IAEA-209)
IODINE COMPOUNDS/DISSOCIATION
Rotational distributions from photodissociation. II. Results for $ICN+h\nu \rightarrow I+CN(X\ ^2\Sigma^+)$, 4:39769
IODINE COMPOUNDS/PHOTON-MOLECULE COLLISIONS
Rotational distributions from photodissociation. II. Results for $ICN+h\nu \rightarrow I+CN(X\ ^2\Sigma^+)$, 4:39769
IODINE COMPOUNDS/ROTATIONAL STATES
Rotational distributions from photodissociation. II. Results for $ICN+h\nu \rightarrow I+CN(X\ ^2\Sigma^+)$, 4:39769
IODINE IONS/ELECTRON LOSS
Absolute charge state yields of 20 MeV ^{127}I ions emerging from a gas stripper, 4:39792 (LA-7445-C)
ION BEAM TARGETS/RESEARCH PROGRAMS
Lawrence Livermore Laboratory heavy ion fusion program, 4:40016 (UCRL-82120)
ION BEAM TYPE REACTORS
See I-BEAM TYPE REACTORS
ION BEAMS/BEAM OPTICS
Effects of the Coulomb explosion on the transmission of molecular ions through a tandem, 4:39771 (LA-7445-C)
ION BEAMS/CONTROL EQUIPMENT
Microcomputer-based multiplexer for performing depth profiling with an Auger electron spectrometer, 4:39774
ION BEAMS/HEAVY IONS
Principles of pulsing for tandem accelerators, 4:39431 (LA-7445-C)
ION BEAMS/MEETINGS
High power electron and ion beam research and technology, 4:39439 (CONF-771035-P2)
ION BEAMS/PULSE TECHNIQUES
Principles of pulsing for tandem accelerators, 4:39431 (LA-7445-C)
ION BEAMS/STOCHASTIC PROCESSES
Stochastic cooling theory and devices, 4:39410 (LBL-7574)
ION BEAMS/USES
Electron and ion beam science and technology, 4:39343
ION COLLISIONS
See also ION-ATOM COLLISIONS
ION-MOLECULE COLLISIONS
ION COLLISIONS/DISCRETE ORDINATE METHOD
Sputtering calculations with the discrete-ordinates method, 4:39781
ION COLLISIONS/SPUTTERING
Sputtering calculations with the discrete-ordinates method, 4:39781
ION RINGS/STABILITY
High frequency stability of field-reversed ion rings in a background plasma, 4:39987 (N-78-28941)
ION SOURCES/PERFORMANCE
Development and testing of a three-stage double tandem accelerator-decelerator system for low energy, highly stripped ions. Progress report, March 1, 1978-February 28, 1979, 4:39978 (COO-4257-3)
Operating experience with an 834 Hiconex sputter ion source, 4:39427 (LA-7445-C)
ION SOURCES/TEST FACILITIES
Single-crate stand-alone CAMAC control system for a negative ion source test facility, 4:39426 (CONF-790327-10)
ION-ATOM COLLISIONS/EXCITATION
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978-May 31, 1979 (Summaries of research activities at Univ., Missouri), 4:39791 (COO-2718-7)
ION-DRAG ACCELERATORS
See ELECTRON-RING ACCELERATORS
ION-MOLECULE COLLISIONS/RESEARCH PROGRAMS
Molecular beam studies of low energy reactions. Annual summary report (0.01 to 20 eV), 4:39788 (AD-A-059845)
IONOSPHERE/CHEMICAL COMPOSITION
Various measurements of atmospheric parameters from incoherent scattering of nightglow, 4:39764 (N-78-30753)
IONOSPHERE/DISTURBANCES
Magnetic substorms and ionospheric storms. A measurement network covering at least the entire Pacific area is seen as the key to the development of complete storm morphologies and a prediction capability. Interim report February 1976-January 1978, 4:39765 (AD-A-057975)
IONOSPHERE/ELECTRON DENSITY
Various measurements of atmospheric parameters from incoherent scattering of nightglow, 4:39764 (N-78-30753)
IONOSPHERE/ENERGY BALANCE
Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 October 1976-31 December 1977, 4:39762 (AD-A-058684)
IONOSPHERE/KINETICS
Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 October 1976-31 December 1977, 4:39762 (AD-A-058684)
IONOSPHERE/PLASMA DRIFT
Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 October 1976-31 December 1977, 4:39762 (AD-A-058684)
IONOSPHERE/WAVE PROPAGATION
Compilation of ionlab riometer data for IMS workshop in Hankasalmi, 4:39763 (N-78-28732)
IONS
See also MOLECULAR IONS
IONS/MOBILITY
Drift mobility correlation in a simple cubic lattice, 4:39105
IRAN/DESALINATION REACTORS
Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants, 4:38706 (IAEA-206)
Status of desalination projects in Iran, 4:38708 (IAEA-206)

IRAN/DUAL-PURPOSE POWER PLANTS
Implementation of the dual-purpose principle in Iran, Bushehr desalination and nuclear power plants, 4:38706 (IAEA-206)
Status of desalination projects in Iran, 4:38708 (IAEA-206)
IRAQ/PETROLEUM INDUSTRY
Activities of the Iraqi State Establishment for oil projects, 4:38927
IRIDIUM ALLOYS
See also IRIDIUM BASE ALLOYS
IRIDIUM ALLOYS/CHEMICAL COMPOSITION
Selected advances in materials research, 4:39106 (CONF-790343-1)
IRIDIUM BASE ALLOYS/ELECTRON BEAM WELDING
Electron-beam welding of thorium-doped iridium alloy sheets (Ir-0.3% W 200 ppM Th-50 ppM Al), 4:39092 (ORNL/TM-6711)
IRIDIUM BASE ALLOYS/GAS METAL-ARC WELDING
Electron-beam welding of thorium-doped iridium alloy sheets (Ir-0.3% W 200 ppM Th-50 ppM Al), 4:39092 (ORNL/TM-6711)
IRON/BAND THEORY
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)
IRON/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
IRON/ELECTRONIC STRUCTURE
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)
IRON/EMISSION SPECTROSCOPY
Spectral method for determining impurities in anthracite and oil coke, 4:38084
IRON/ION EXCHANGE
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
IRON/METALLURGICAL EFFECTS
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL-81879)
IRON/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
IRON/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
IRON/PION PLUS REACTIONS
Low energy πi scattering from light nuclei, 4:39896
IRON/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
IRON 55/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
IRON ALLOYS
See also IRON BASE ALLOYS
IRON ALLOYS/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
IRON ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
IRON ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
IRON ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
IRON BASE ALLOYS
See also INCOLOY ALLOYS
IRON BASE ALLOYS/CORROSION
Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978-31 May 1979, 4:39091 (COO-2960-3)
IRON COMPLEXES/SYNTHESIS
Synthesis and characterization of the mixed-metal alkylidyne clusters RcFeCo2(CO)9h (r = CH3, C2H5, C6H5). Interim technical report, 4:39216 (AD-A-058229)
IRON IONS/ELECTRON LOSS
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
IRON IONS/EMISSION SPECTRA
Dielectronic satellite spectrum of helium-like iron (Fe XXV), 4:39973 (PPPL-1538)
IRON IONS/ION-MOLECULE COLLISIONS
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu (Preliminary cross sections, electron pickup and loss, 3.4 to 8.5 MeV/amu), 4:39795 (LBL-8932)
IRON OXIDES/CHEMICAL ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
IRON SULFIDES/CATALYTIC EFFECTS
Mineral matter effects and catalyst characterization in coal liquefaction. Annual report, October 1977-September 1978, 4:38078 (SAND-79-0505)
IRRADIATION DEVICES/DESIGN
American national standard N433.1; safe design and use of self-contained, dry source storage gamma irradiators (Category I). Final report, 4:38303 (PB-285117)
IRRADIATION DEVICES/SAFETY
American national standard N433.1; safe design and use of self-contained, dry source storage gamma irradiators (Category I). Final report, 4:38303 (PB-285117)
IRRIGATION/COST BENEFIT ANALYSIS
Energy price levels and the economics of irrigation, 4:39031
IRRIGATION/ECONOMICS
Projected energy and water consumption of Pacific Northwest irrigation systems, 4:39657 (PNL-RAP-33)
IRRIGATION/ENERGY CONSUMPTION
Projected energy and water consumption of Pacific Northwest irrigation systems, 4:39657 (PNL-RAP-33)
IRRIGATION/ENERGY DEMAND
Energy price levels and the economics of irrigation, 4:39031
IRRIGATION/MANPOWER
Projected energy and water consumption of Pacific Northwest irrigation systems, 4:39657 (PNL-RAP-33)
IRRIGATION/POWER DEMAND
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
IRRIGATION/WATER REQUIREMENTS
Projected energy and water consumption of Pacific Northwest irrigation systems, 4:39657 (PNL-RAP-33)
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
ISABELLE STORAGE RINGS/BEAM DYNAMICS
Correction of the closed orbit and vertical dispersion and the tuning and field correction system in ISABELLE, 4:39467 (BNL-25755)
ISABELLE STORAGE RINGS/BEAM INJECTION
Beam transfer from the AGS to ISABELLE, 4:39469 (BNL-25783)
ISABELLE STORAGE RINGS/BEAM STACKING
Enhanced resistive wall instability for off-centered beams, 4:39470 (BNL-25793)
ISABELLE STORAGE RINGS/SPECIFICATIONS
Status of ISABELLE lattice, 4:39471 (BNL-25798)
ISABELLE STORAGE RINGS/SUPERCONDUCTING MAGNETS
Design, construction, and operation update of the ISABELLE ring magnets, 4:39473 (BNL-25822)
ISABELLE magnet support and adjustment system, 4:39472 (BNL-25799)
ISABELLE STORAGE RINGS/TUNING
Correction of the closed orbit and vertical dispersion and the tuning and field correction system in ISABELLE, 4:39467 (BNL-25755)
ISABELLE STORAGE RINGS/VACUUM SYSTEMS
Factors determining the choice of the beam tube material and the vacuum chamber design for a superconducting high energy storage accelerator, 4:39437 (BNL-25797)
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
ISING MODEL/PARTITION FUNCTIONS
Yang-Lee edge singularity in the hierarchical model, 4:39947
ISING MODEL/SINGULARITY
Yang-Lee edge singularity in the hierarchical model, 4:39947
ISOBARIC NUCLEI
(Nuclei having identical mass numbers; see also specific nuclides.)
ISOBARIC NUCLEI/PHOTOPRODUCTION
Isobars and the medium-energy (γ,p) reaction, 4:39888
ISOBUTANE
See 2-METHYLPROPANE
ISOTOPE SEPARATION PLANTS/SAFEGUARDS
Minor isotope measurements for safeguarding a uranium enrichment plant, 4:38290 (K/OA-4488)
ISX TOKAMAK/CHARGE EXCHANGE
Charge exchange measurements on ISX-A, 4:39979 (ORNL/TM-6823)
ISX TOKAMAK/CONFINEMENT TIME
Maximum energy-confinement time in Joule-heated tokamaks, 4:39969
Plasma confinement studies in the ISX-A tokamak, 4:39970

ISX TOKAMAK/ENERGY
Maximum energy-confinement time in Joule-heated tokamaks, 4:39969
ISX TOKAMAK/GAS ANALYSIS
Residual gas analysis in the ISX-A tokamak, 4:40026
ISX TOKAMAK/IMPURITIES
Surface impurity studies in the ISX-A tokamak, 4:40027
ISX TOKAMAK/JOULE HEATING
Maximum energy-confinement time in Joule-heated tokamaks, 4:39969
Plasma confinement studies in the ISX-A tokamak, 4:39970
ITALY/GEOTHERMAL POWER PLANTS
Geothermal power plants of Italy: A technical survey of existing installations, 4:38538 (COO-4051-34)
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
ITALY/WATER WAVES
Preliminary considerations on wave motion measurements. enel's wave meter network, 4:38561
IUS
See TOTAL ENERGY SYSTEMS

J

J-3105 RESONANCES
See PSI-3105 RESONANCES
JAPAN/ENERGY CONSUMPTION
Crude oil and products markets in industrial countries. VII. Japan, 4:38928
JAPAN/ENERGY SOURCE DEVELOPMENT
Reference data: a basic plan for research and development, 4:38509
JAPAN/GEOTHERMAL ENERGY
A consideration of geothermal energy, 4:38529
Development of geothermal energy in Japan, 4:38517
New energy technology- Strategy and evaluation, 4:38511
JAPAN/GEOTHERMAL EXPLORATION
How to develop geothermal energy in Japan, 4:38537
JAPAN/GEOTHERMAL POWER PLANTS
Development of geothermal energy in Japan, 4:38517
How to develop geothermal energy in Japan, 4:38537
Status of geothermal energy development in 1976, 4:38536
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
JAPAN/HOT SPRINGS
Geothermal survey with infrared radiation thermometer and thermister thermometer- Namekawa Spa and Ubayu Spa, 4:38522
JAPAN/PETROLEUM PRODUCTS
Crude oil and products markets in industrial countries. VII. Japan, 4:38928
JAPAN/RESEARCH PROGRAMS
Reference data: a basic plan for research and development, 4:38509
JAPAN/SUNSHINE PROJECT
Geothermal energy technology, 4:38544
JAPAN/THERMAL WATERS
Recent developments in geothermal multipurpose utiliztaion in Jozankei Hot Springs in Sapporo City, 4:38552
Report of the Geothermal Utilization Committee, 4:38549
JEMEZ MOUNTAINS/GEOLOGY
Geohydrologic data from the Jemez Mountains and vicinity, north-central New Mexico. Final report, 4:38513 (PB-284221)
JEMEZ MOUNTAINS/GEOTHERMAL EXPLORATION
Geohydrologic data from the Jemez Mountains and vicinity, north-central New Mexico. Final report, 4:38513 (PB-284221)
JEMEZ MOUNTAINS/HYDROLOGY
Geohydrologic data from the Jemez Mountains and vicinity, north-central New Mexico. Final report, 4:38513 (PB-284221)
JET ENGINE FUELS/COMBUSTION KINETICS
Combustion kinetics of selected aromatic hydrocarbons. Interim report 1 Jun 77-13 May 78, 4:38174 (AD-A-059381)
JETS/FLUID FLOW
Entrainment solutions for jet discharge into deep water, 4:39624
JOSEPHSON JUNCTIONS/PERTURBATION THEORY
Perturbation calculation of the I-V characteristic of an extended Josephson junction, 4:39956
JUICES
See BEVERAGES
JUPITER PLANET/PLANETARY MAGNETOSPHERES
Discrepancy in proton flux extrapolation along field lines in the middle Jovian magnetosphere, 4:39759 (N-78-31028)
JUPITER PLANET/SHORT WAVE RADIATION
An emission mechanism for the Io-independent Jovian decameter radiation, 4:39758 (N-78-31027)

K

KALKAR POWER REACTOR
See SNR-1 REACTOR
KALPAKKAM LMFBR REACTOR
Computer supervision of the core outlet sodium temperatures of FBTR, 4:38699
KAOLINITE/SORPTIVE PROPERTIES
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
KAON BEAMS/USES
Physics uses of intense proton beams at 10 to 20 GeV (Kaon factory utilization), 4:39454 (LA-UR-79-898)
KAON MINUS REACTIONS/STRANGENESS-EXCHANGE REACTIONS
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)
KAON REACTIONS
Kaon interactions with very light nuclei (Review, cross sections), 4:39831 (LA-UR-79-653)
KAON-DEUTERON INTERACTIONS
Kaon interactions with very light nuclei (Review, cross sections), 4:39831 (LA-UR-79-653)
KARLSRUHE RESEARCH REACTOR FR-2
See FR-2 REACTOR
KELP
See SEAWEEDS
KENTUCKY/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
KENTUCKY/RESOURCE DEVELOPMENT
A Kentucky Energy Resource Utilization program. Semiannual report, 1 July-31 December 1977, 4:38042 (PB-283796)
KENTUCKY/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
KENTUCKY/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
KEPONE/ECOLOGICAL CONCENTRATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
KEPONE/ENVIRONMENTAL EXPOSURE PATHWAY
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
KGRA
(Known geothermal resource area.)
KGRA/MAPS
Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790, 4:38514
Geothermal energy in Alaska and Hawaii. Map 2 of U.S. Geological Survey Circular 790, 4:38515
KLYSTRONS/COMPARATIVE EVALUATIONS
Advances in high-power rf amplifiers, 4:39452 (LA-UR-79-705)
KNK REACTOR/REACTOR NOISE
Noise analysis performed at the sodium cooled power reactor KNK 1 for malfunctioning diagnosis and plant surveillance, 4:38693
KNOCK-ON ELECTRONS
See ELECTRONS
KOMPAKTE NATRIUMGEKUEHLTE REAKTOR
See KNK REACTOR
KRAFLA GEOTHERMAL FIELD/FLUID FLOW
Simulation of the Krafla Geothermal Field, 4:38518 (LBL-7076)
KRAFLA GEOTHERMAL FIELD/GEOLOGY
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO-4051-38)
KRAFLA GEOTHERMAL FIELD/SIMULATION
Simulation of the Krafla Geothermal Field, 4:38518 (LBL-7076)
KRYPTON/CHARGED-PARTICLE TRANSPORT
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
KRYPTON/RECOVERY
Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report, 4:38243 (IDO-1540-T1)

KRYPTON 85/RADIOACTIVE WASTE DISPOSAL
Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976, 4:38251 (IAEA-209)
KRYPTON 86 REACTIONS
Dynamical birth and thermal death of angular momentum in heavy ion reactions (Collective model, 600 MeV, cross sections, J), 4:39914 (LBL-8613)
KRYPTON IONS/ION-MOLECULE COLLISIONS
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu (Preliminary cross sections, electron pickup and loss, 3.4 to 8.5 MeV/amu), 4:39795 (LBL-8932)

L

LABORATORY EQUIPMENT
See also FUME HOODS
SAMPLERS
LABORATORY EQUIPMENT/MEASURING INSTRUMENTS
Laboratory instruments, (Brazil). Foreign market survey report, 4:39487 (DIB-78-12-501)
LAKE MICHIGAN/EUTROPHICATION
Nutrient enrichment and eutrophication of Lake Michigan. Progress report, November 1, 1975-September 30, 1978, 4:39608 (COO-2003-T1)
LAKE MICHIGAN/NUTRIENTS
Nutrient enrichment and eutrophication of Lake Michigan. Progress report, November 1, 1975-September 30, 1978, 4:39608 (COO-2003-T1)
LAKES
See also LAKE MICHIGAN
LAKES/LIMNOLOGY
Historical, physical, and chemical limnology of Twin Lakes, Colorado, 4:39632 (PB-283848)
LAMBDA NEUTRAL
See LAMBDA PARTICLES
LAMBDA PARTICLES/MASS SPECTRA
ΛK and ΣK systems observed in π^+ interactions at 10.3 GeV/c (Peripheral phase space, broad theshold enhancements), 4:39864
LAMPF LINAC/BEAM DYNAMICS
Pion beam development for the LAMPF biomedical project, 4:39453 (LA-UR-79-714)
LAMPF LINAC/OPERATION
Medium-energy physics program. Quarterly report, May 1-July 31, 1978, 4:39377 (LA-7650-PR)
LAMPF LINAC/PHYSICAL RADIATION EFFECTS
LAMPF primary beam line protection system, 4:39406 (LA-UR-79-750)
LAMPF LINAC/PION BEAMS
Pion beam development for the LAMPF biomedical project, 4:39453 (LA-UR-79-714)
LAMPF LINAC/POLARIZED BEAMS
800-MeV spin precessor for polarized H^- beams using H^- to H^0 stripping, 4:39407 (LA-UR-79-751)
LAMPF LINAC/RADIATION PROTECTION
LAMPF primary beam line protection system, 4:39406 (LA-UR-79-750)
LAMPF LINAC/REMOTE HANDLING EQUIPMENT
Monitor 1979, 4:39451 (LA-UR-79-689)
LAMPF LINAC/RESEARCH PROGRAMS
Medium-energy physics program. Quarterly report, May 1-July 31, 1978, 4:39377 (LA-7650-PR)
LAMPF LINAC/STORAGE RINGS
Neutral beam injection for a proton storage ring, 4:39432 (LA-UR-79-703)
LAMPF LINAC/TARGETS
Graphite targets for use in high intensity beams at LAMPF, 4:39450 (LA-UR-79-688)
LAND FILLS
See SANITARY LANDFILLS
LAND POLLUTION/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
LAND TRANSPORT/ENERGY CONSUMPTION
The energy cost of road and rail transport in Tasmania, 4:39025 (PB-283952)
LAND USE/MANAGEMENT
Resources, residuals and irreversible land conversions: prototype management instruments, 4:38877 (PB-283968)
LANGUAGES (PROGRAMMING)
See PROGRAMMING LANGUAGES
LANTHANIDES
See RARE EARTHS
LANTHANUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
LANTHANUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
LANTHANUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
LANTHANUM COMPOUNDS/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
LANTHANUM COMPOUNDS/MICROSTRUCTURE
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
LANTHANUM COMPOUNDS/SEED-SLAG INTERACTIONS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
LANTHANUM OXIDES/CATALYTIC EFFECTS
Influence of f-electron configuration on catalytic properties of lanthanide oxides, 4:39242 (LBL-8975)
Physical and catalytic properties of oxides, 4:39230 (LBL-8975)
LANTHANUM OXIDES/ELECTRICAL PROPERTIES
Physical and catalytic properties of oxides, 4:39230 (LBL-8975)
LARVAE
Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey, 4:39614 (IVL-B-445)
LASER CAVITIES/DESIGN
Laser plasma tube having internal gas path (Patent), 4:39302
LASER FUSION REACTORS/VACUUM SYSTEMS
Shiva and Argus target diagnostics vacuum systems, 4:40021
LASER MATERIALS
Glasses suitable for laser application (Patent), 4:39300
LASER RADIATION/BIOLOGICAL EFFECTS
Mechanisms of retinal damage from chronic laser radiation. Thresholds and mechanisms. Annual report, No. 4. 1 November 1976-31 October 1977, 4:39699 (AD-A-058449)
LASER RADIATION/HEALTH HAZARDS
Laser eye protection for flight personnel. Volume I. Phase report, 4:39698 (AD-A-057417)
LASER RADIATION/PHOTODETECTORS
Picosecond photodetector for 257 nm to 1 μm laser pulses, 4:39296
LASER TARGETS/ENERGY TRANSFER
Laser-plasma coupling, 4:40015 (UCRL-81896)
LASER TARGETS/SURFACE COATING
Magnetron sputter coating of microspherical substrates, 4:40018
LASER-PRODUCED PLASMA/EMISSION SPECTRA
Emission of energetic electrons from a Nd-laser-produced plasma. Interim report, 4:39985 (AD-A-059877)
LASER-PRODUCED PLASMA/OPTICAL REFLECTION
Absorption of laser radiation by a dense expanding plasma, 4:39986
LASERS
See also CARBON DIOXIDE LASERS
CHEMICAL LASERS
DYE LASERS
FREE ELECTRON LASERS
GAMMA-RAY LASERS
GAS LASERS
NEODYMIUM LASERS
RUBY LASERS
SEMICONDUCTOR LASERS
LASERS/EMISSION SPECTRA
Features of high-frequency pulsation generation in a ring laser with detuning, 4:39319
LASERS/GAIN
Optical and infrared lasers. Final report, 1 December 1972-31 March 1978, 4:39291 (N-78-28437)
LASERS/NUCLEAR PUMPING
Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission), 4:38788
Proton beam excited lasers, 4:39286 (CONF-771035-P2)
LASERS/OPTICAL PUMPING
Solar pulser for laser pumping (Patent), 4:39303

LASERS/USES
Miniature TEA laser emitting picosecond pulses laser tea miniature emettant des pulses picosecondes, 4:39292 (N-78-28450)
LASL
(Los Alamos Scientific Laboratory.)
LASL/RESEARCH PROGRAMS
Neutron physics at LASL, 4:39378
LATENT HEAT OF VAPORIZATION
See VAPORIZATION HEAT
LATENT HEAT STORAGE
Trombe wall with phase change storage material, 4:38457 (CONF-780337-P3)
LATENT HEAT STORAGE/MATERIALS TESTING
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
Engineering design for thermocrete central storage units for low temperature solar application. Monthly technical report, August-September 1978, 4:38505 (COO-4702-3)
LATENT HEAT STORAGE/REVIEWS
Design concepts for solar heating in a Mediterranean climate, 4:38461 (CONF-7709179-1)
LATENT HEAT STORAGE/THERMAL ENERGY STORAGE EQUIPMENT
Engineering design for thermocrete central storage units for low temperature solar application. Monthly technical report, August-September 1978, 4:38505 (COO-4702-3)
LATHES/CONTROL EQUIPMENT
Interfacing the linear motor slide drive to a precision machine tool, 4:39263 (Y-2180)
LATTICES (REACTOR)
See REACTOR LATTICES
LAWRENCE LIVERMORE LABORATORY/BIBLIOGRAPHIES
Earth Sciences Division, collected abstracts, 1978, 4:39706 (UCRL-52681)
LAWRENCE LIVERMORE LABORATORY/RESEARCH PROGRAMS
Energy and technology review, 4:39293 (UCRL-52000-79-3)
LEACHING/MATHEMATICAL MODELS
Earth Sciences, 4:38087 (ORNL-5508)
LEACHING/MEASURING METHODS
Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB-285072)
LEAD/ADSORPTION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
LEAD/BIOLOGICAL EFFECTS
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
LEAD/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
LEAD/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb → π^{+-}, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)
LEAD/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
LEAD/MUTAGENESIS
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
LEAD/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
LEAD/PHOTONUCLEAR REACTIONS
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
LEAD/PRECIPITATION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
LEAD/X-RAY FLUORESCENCE ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
LEAD 208 TARGET/OXYGEN 16 REACTIONS
Energy dependence of peripheral reactions induced by heavy ions (Differential cross sections, 140 and 315 MeV, yields), 4:39915
LEAD 208 TARGET/PION MINUS REACTIONS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
LEAD 210/DELAYED RADIATION EFFECTS
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL-78-65(Pt.2))
LEAD 210/INGESTION
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL-78-65(Pt.2))
LEAD 210/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
LEAD 210/RADIOECOLOGICAL CONCENTRATION
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
LEAD OXIDES/ARGON 40 REACTIONS
Multipion production in nuclear collisions, 4:39934 (LBL-8758)
LEAD OXIDES/CHEMICAL ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
LEAD-ACID BATTERIES/BATTERY SEPARATORS
Phenolic resin composition and a battery separator impregnated therewith (Patent), 4:38852
LEAD-ACID BATTERIES/CATHODES
Lead crystal storage cells and storage devices made therefrom (Patent), 4:38855
LEAD-ACID BATTERIES/CONDUCTOR DEVICES
Battery container having cast battery terminal formed therein (Patent), 4:38857
LEAD-ACID BATTERIES/CONTAINERS
Battery container having cast battery terminal formed therein (Patent), 4:38857
LEAK TESTING/ERRORS
Measurement error in pressure-decay leak testing, 4:39259 (ORNL/TM-6855)
LEED
See ELECTRON DIFFRACTION
LENS (CRYSTALLINE)
See CRYSTALLINE LENS
LEPTONS
See also ELECTRONS
MUONS
LEPTONS/PAIR PRODUCTION
Multilepton final states and the weak interactions of the fifth quark, 4:39850
LIBYA/ENERGY POLICY
Energy situation in the Arab world, 4:38923
LIFE SUPPORT SYSTEMS/PERFORMANCE TESTING
Testing program for mining coal in an oxygen free atmosphere. Volume 1. Final report, 4:38103 (PB-285122)
LIGHT NUCLEI/KAON REACTIONS
Kaon interactions with very light nuclei (Review, cross sections), 4:39831 (LA-UR-79-653)
LIGHT TRANSMISSION/MEASURING METHODS
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
LIGHTING SYSTEMS/DESIGN
Low energy sign illumination system (Patent), 4:39036
LIGHTING SYSTEMS/ENERGY EFFICIENCY
National energy plan: energy conservation in lighting. Final report, 4:39014 (HIT-692)
LIGHTNING ARRESTERS/CONNECTORS
Dielectric stimulated arcs in lightning arrestor connectors, 4:38614 (SAND-79-0396C)
LIGHTNING ARRESTERS/ELECTRICAL INSULATION
Dielectric stimulated arcs in lightning arrestor connectors, 4:38614 (SAND-79-0396C)
LIGNITE/CHEMICAL COMPOSITION
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)
LIMITERS/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
LINACS
See LINEAR ACCELERATORS
LINEAR ACCELERATORS
See also LAMPF LINAC
SUPERHILAC
LINEAR ACCELERATORS/BEAM BUNCHING
Antiproton momentum compactor-debuncher linac, 4:39420 (LBL-7574)
LINEAR ACCELERATORS/BEAM DYNAMICS
Linac particle tracing simulations, 4:39404 (LA-UR-79-709)
Rf quadrupole beam dynamics, 4:39408 (LA-UR-657)
Stable particle motion in a linear accelerator with solenoid focusing, 4:39403 (LA-UR-79-701)

LINEAR ACCELERATORS/BEAM FOCUSING MAGNETS
Stable particle motion in a linear accelerator with solenoid focusing, 4:39403 (LA-UR-79-701)
LINEAR ACCELERATORS/BEAM OPTICS
Radio frequency quadrupole accelerating structure research at Los Alamos, 4:39401 (LA-UR-79-695)
LINEAR ACCELERATORS/BEAM TRANSPORT
Radio frequency quadrupole accelerating structure research at Los Alamos, 4:39401 (LA-UR-79-695)
LINEAR ACCELERATORS/CAVITY RESONATORS
Experimental and calculated rf properties of the disk-and-washer structure, 4:39449 (LA-UR-79-685)
Room-temperature cavities for high-beta accelerating structures, 4:39446 (LA-UR-79-463)
LINEAR ACCELERATORS/ELECTRODES
Experimental and calculated rf properties of the disk-and-washer structure, 4:39449 (LA-UR-79-685)
LINEAR ACCELERATORS/FABRICATION
Mechanical technologies for PIGMI (Pion Generator for Medical Irradiations), 4:39447 (LA-UR-79-651)
LINEAR ACCELERATORS/MEETINGS
High power electron and ion beam research and technology, 4:39439 (CONF-771035-P2)
LINEAR ACCELERATORS/MICROWAVE RADIATION
Coherent microwave scattering from intense relativistic electron beams: a powerful, tunable source of millimeter and submillimeter radiation, 4:39333 (CONF-771035-P2)
LINEAR ACCELERATORS/PERFORMANCE
Initial performance of the PIGMI prototype (Pion Generator for Medical Irradiations), 4:39448 (LA-UR-79-658)
LINEAR ACCELERATORS/PION BEAMS
Mechanical technologies for PIGMI (Pion Generator for Medical Irradiations), 4:39447 (LA-UR-79-651)
LINEAR ACCELERATORS/POWER SUPPLIES
Inductive storage for high power REB accelerators, 4:39440 (CONF-771035-P2)
LINEAR ACCELERATORS/PULSE SHAPERS
Properties of a linac-storage ring stretcher system, 4:39482 (SLAC-PUB-2262)
LINEAR ACCELERATORS/SERVICE LIFE
Operation of repetitively pulsed 300 kV, 20 kA electron beam diode, 4:39461 (SAND-79-0596C)
LINEAR ACCELERATORS/SPACE CHARGE
Linac particle tracing simulations, 4:39404 (LA-UR-79-709)
LINEAR ACCELERATORS/TARGETS
Photoneutron target design for fast neutron spectrum measurements, 4:39444 (COO-4933-1)
LIOUVILLE THEOREM
Are we beating Liouville's theorem, 4:39415 (LBL-7574)
LIQUEFIED NATURAL GAS/INTERCHANGEABILITY
Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
LIQUEFIED NATURAL GAS/SUPPLY AND DEMAND
Natural gas shortage. Final report, 4:38178 (PB-283875)
LIQUEFIED PETROLEUM GASES/INTERCHANGEABILITY
Survey and laboratory experiences in fuel gas supplementation and interchangeability at IGT, 4:38175
LIQUID CRYSTALS/ULTRASONIC WAVES
Anisotropic ultrasound propagation in a smectic-A liquid crystal, 4:39194
Ultrasonic study of a smectic-B liquid crystal, 4:39193
LIQUID LASERS/POLARIZATION
Influence of the degree of polarization on the gain in stimulated Raman scattering, 4:39310
LIQUID LASERS/RAMAN EFFECT
Influence of the degree of polarization on the gain in stimulated Raman scattering, 4:39310
LIQUID METAL FAST BREEDER REACTORS
See LMFBR TYPE REACTORS
LIQUID METAL TEST FACILITIES
See TEST FACILITIES
LIQUID METAL-WATER REACTIONS
See MOLTEN METAL-WATER REACTIONS
LIQUID WASTES
See also WASTE WATER
LIQUID WASTES/ENVIRONMENTAL EFFECTS
Burial ground technology, 4:39603 (ORNL-5508)
LIQUID WASTES/SAMPLING
General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities, 4:38288
LIQUID WASTES/WASTE PROCESSING
Removal of heavy metals from industrial wastewaters using insoluble starch xanthate. Final report, July 1975-June 1976, 4:39351 (PB-283792)
LIQUIDS
See also LIQUID CRYSTALS
LIQUIDS/ROTATION
Wave resistance in a rotating liquid layer, 4:39327 (UCRL-82436)
LITHIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
LITHIUM 6 TARGET/DEUTERON REACTIONS
Absolute cross sections for three-body breakup reactions ^{6}Li(d,n ^{3}He)^{4}He and ^{6}Li(d,p ^{3}H)^{4}He, 4:39894
LITHIUM 6 TARGET/NEUTRON REACTIONS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
New measurement of the ^{6}Li(n,α)T cross section (3 to 800 keV), 4:39897
Summary documentation for ^{6}Li (10 eV to 550 keV), 4:39892 (LA-7663-MS)
LITHIUM COMPOUNDS/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
LITHIUM COMPOUNDS/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
LITHIUM IONS/ION-ATOM COLLISIONS
Many-electron aspects of molecular promotion in ion-atom collisions: Production of core-excited states of Li in Li^{+}-He collisions, 4:39798
LITHIUM ISOTOPES/NUCLEOSYNTHESIS
Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50-90 MeV, 4:39895
LITHIUM-CHLORINE BATTERIES/PERFORMANCE TESTING
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)
LITHIUM-SULFUR BATTERIES/CATHODES
Cells having cathodes containing C/sub s/S cathode-active materials (Patent), 4:38856
Process for manufacture of positive electrode for lithium/metal sulfide secondary cell (Patent), 4:38854
LITHIUM-SULFUR BATTERIES/ELECTROLYTES
Cells having cathodes containing C/sub s/S cathode-active materials (Patent), 4:38856
LITHIUM-SULFUR BATTERIES/PERFORMANCE TESTING
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)
LIVER/RADIATION DOSES
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
LIXIVIATION
See LEACHING
LMFBR TYPE REACTORS
See also BOR-60 REACTOR
CLINCH RIVER BREEDER REACTOR
EBR-2 REACTOR
FFTF REACTOR
KALPAKKAM LMFBR REACTOR
PEC BRASIMONE REACTOR
PFR REACTOR
SNR-1 REACTOR
LMFBR TYPE REACTORS/BOILING DETECTION
Boiling detection in fast reactors by noise analysis studies performed in France, 4:38695
Detection of local boiling in an LMFBR subassembly by temperature fluctuations analysis at the outlet, 4:38694
Detection of sodium vapor bubble collapse in a liquid metal fast breeder reactor, 4:38698
LMFBR TYPE REACTORS/BREEDING BLANKETS
MIT LMFBR blanket research project. Quarterly progress report, October 1-December 31, 1978, 4:38665 (COO-2250-35)
LMFBR TYPE REACTORS/COMMERCIALIZATION
Proceedings of the workshop on institutional alternatives for LMFBR development and commercialization held at the Mitre Corporation in McLean, Virginia on September 8 and 9, 1976. Final report, 4:38688 (PB-284227)
LMFBR TYPE REACTORS/FUEL ASSEMBLIES
Noise and DC balanced outlet temperature signals for monitoring coolant flow in LMFBR fuel elements, 4:38692
Rod-bundle thermal-hydraulic analysis using boundary-fitted coordinate system, 4:38684 (NUREG/CR-0001)
LMFBR TYPE REACTORS/FUEL CYCLE
Pyrochemical coprocessing of UO_2-PuO_2 LMFBR fuel by the Salt Transport Method, 4:38242 (RFP-2887)

LMFBR TYPE REACTORS/FUEL ELEMENT CLUSTERS
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, September 1, 1978-November 30, 1978, 4:38664 (COO-2245-66)
Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1978-August 31, 1978, 4:38663 (COO-2245-65)
In-pile investigation of local cooling disturbance in LMFBR's (Mol 7C), 4:38803 (INIS-mf-4426)
LMFBR TYPE REACTORS/FUEL ELEMENT FAILURE
Theoretical and experimental investigation of the nonlinear structural dynamics of Fast Breeder Reactor fuel elements, 4:38679 (KFK-2584)
LMFBR TYPE REACTORS/FUEL ELEMENTS
Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation, 4:38680 (KFK-2619)
LMFBR TYPE REACTORS/FUEL PINS
Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA-1543-FP)
Fuel pin simulators for sodium boiling tests in the THORS facility, 4:38687 (ORNL/TM-6688)
HEDL mixed oxide fuel pin breach experience in EBR-II, 4:38669 (HEDL-SA-1535-FP)
Mixed oxide run-beyond-cladding-breach tests in EBR-II, 4:38670 (HEDL-SA-1536-FP)
Short terms experiments in BR2 towards a better fast fuel performance analysis, 4:38675 (INIS-mf-4426)
Steady state irradiation behavior of mixed oxide fuel pins irradiated in EBR-II, 4:38672 (HEDL-SA-1683-FP)
LMFBR TYPE REACTORS/FUEL-CLADDING INTERACTIONS
Chemical interaction at the FBR cladding fuel interfaces, 4:38674 (INIS-mf-4426)
LMFBR TYPE REACTORS/HEAT EXCHANGERS
Review on fluid forces on circular cylinders in cross flow, 4:38662 (ANL-CT-79-16)
LMFBR TYPE REACTORS/MEETINGS
International Working Group on Fast Reactors eleventh annual meeting. Summary report, Part III, 4:38678 (IWGFR-24-3)
Proceedings of the workshop on institutional alternatives for LMFBR development and commercialization held at the Mitre Corporation in McLean, Virginia on September 8 and 9, 1976. Final report, 4:38688 (PB-284227)
LMFBR TYPE REACTORS/MELTDOWN
Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries, 4:38791 (BNL-NUREG-25714)
In-vessel core debris coolability for large breeder reactors, 4:38800 (GEFR-00415)
LMFBR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Electromagnetic pumps for fast reactors primary cooling circuits, 4:38683 (NIIEFA-A-0340)
Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation, 4:38680 (KFK-2619)
Sodium technology progress report, October-December 1978, 4:38673 (HEDL-TME-78-93)
LMFBR TYPE REACTORS/REACTOR ACCIDENTS
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
LMFBR TYPE REACTORS/REACTOR COMPONENTS
Baseline inspection of three transition joint life test articles, 4:38666 (GEFR-00414)
Sodium technology progress report, October-December 1978, 4:38673 (HEDL-TME-78-93)
LMFBR TYPE REACTORS/REACTOR CORE DISRUPTION
1978 annual report: aerosol characterization from a simulated HCDA, 4:38820 (NUREG/CR-0740)
Analysis of nonlinear fluid structure interaction transient in fast reactors, 4:38790 (ANL-78-103)
Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries, 4:38791 (BNL-NUREG-25714)
LMFBR TYPE REACTORS/REACTOR INTERNALS
COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis, 4:38685 (NUREG/CR-0785)
LMFBR TYPE REACTORS/REACTOR KINETICS
Reactor physics parameters of alternate fueled FBR core designs, 4:38668 (HEDL-SA-1329)
LMFBR TYPE REACTORS/REACTOR MATERIALS
Design rules for high temperature plant - the implications of recent research in relation to current practice, 4:38681
Materials data for severe variable loading, 4:38697
LMFBR TYPE REACTORS/REACTOR SAFETY
Annual technical progress report: reactor safety, Government fiscal year 1978, 4:38798 (ESG-DOE-13254)
LMFBR TYPE REACTORS/THORIUM CYCLE
Reactor physics parameters of alternate fueled FBR core designs, 4:38668 (HEDL-SA-1329)
LNG
See LIQUEFIED NATURAL GAS
LOAD MANAGEMENT
Electrical load management: the British experience. Part II (Nighttime demand at record highs), 4:38937
LOAD MANAGEMENT/IMPLEMENTATION
Demand management demonstration project. Stage 1: development of residential load characteristics and Stage 4: demonstration of residential incremental cost pricing implemented by time-of-day metering. Final report, January 1979, 4:38930 (HCP/B8072-01)
LOBSTERS/AQUACULTURE
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
LOFT REACTOR/LOSS OF COOLANT
Multidimensional analysis based on a two-fluid model of fluid flow in a component of the LOFT system during a loss of coolant experiment, 4:38795 (CONF-790423-3)
LOFT REACTOR/REACTOR MATERIALS
Material compatibility tests for LOFT nuclear reactor fuel centerline thermocouples, 4:38780 (NUREG/CR-0643)
LOFT REACTOR/THERMOCOUPLES
Material compatibility tests for LOFT nuclear reactor fuel centerline thermocouples, 4:38780 (NUREG/CR-0643)
LOGIC CIRCUITS/PHYSICAL RADIATION EFFECTS
Comparison study of the five transistor-transistor-logic (TTL) families and emitter coupled logic (ECL). Final report, 4:39499 (AD-A-058093)
LONGWALL MINING
See also COAL MINING
LONGWALL MINING/STRATA CONTROL
Design, fabrication and field testing of remotely operated longwall head/tail supports. Final report, 4:38101 (PB-285041)
LOOSE PARTS MONITORING
Loose-parts monitoring: present status of the technology, its implementation in U.S. reactors, and some recommendations for achieving improved performance, 4:38730
On-line computerized reactor noise, vibration and loose parts monitoring system, 4:38747
LOS ALAMOS MESON PHYSICS FACILITY
See LAMPF LINAC
LOSS OF COOLANT/FISSION PRODUCT RELEASE
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38817 (NUREG/CR-0698)
LOSS OF COOLANT/FLUID FLOW
Scaling and constitutive relationships in downcomer modeling, 4:38813 (NUREG/CR-0561)
LOSS OF COOLANT/FUEL ELEMENT FAILURE
Technical aspects for PWR safety experiments with single rods and rod bundles in BR2 Mol, 4:38802 (INIS-mf-4426)
LOSS OF COOLANT/HEAT TRANSFER
Application of the FLIRA code to fit ERSEC experiments, 4:38792 (CEA-CONF-3999)
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
Status report on ECC penetration scaling research (PWR), 4:38815 (NUREG/CR-0651)
LOSS OF COOLANT/HYDRAULICS
Application of the FLIRA code to fit ERSEC experiments, 4:38792 (CEA-CONF-3999)
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
Status report on ECC penetration scaling research (PWR), 4:38815 (NUREG/CR-0651)
Two phase interactions in counter-current flow: studies of the flooding mechanism. Annual report, November 1975-October 1977 (PWR), 4:38814 (NUREG/CR-0617)
LOSS OF COOLANT/SIMULATION
PBF-LOCA single rod tests program experiment specification document (PWR), 4:38825 (TFBP-TR-279)
LOSS OF COOLANT/TWO-PHASE FLOW
Two phase interactions in counter-current flow: studies of the flooding mechanism. Annual report, November 1975-October 1977 (PWR), 4:38814 (NUREG/CR-0617)
LOSS OF FLUID TEST REACTOR
See LOFT REACTOR
LOUISIANA/ENERGY CONSERVATION
Energy conservation plan for the state of Louisiana. (Public Law 94-163 and 94-385), 4:39050 (PB-284198)
LOVE WAVES/WAVE PROPAGATION
Relationship between near-field and teleseismic observations of seismic source parameters. Final report 1 Apr 73-30 Sep 77, 4:39526 (AD-A-059529)

LOW BTU GAS/COMBUSTION PROPERTIES
Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 2, Kiln Burner (From natural gas to low Btu gas), 4:38123 (FE-2489-27)
LOW-HEAD HYDROELECTRIC POWER PLANTS
Marketing low-head hydroelectric power, 4:38346
LOW-HEAD HYDROELECTRIC POWER PLANTS/COST BENEFIT ANALYSIS
Very-low-head hydroelectric generation, 4:38338
LOW-HEAD HYDROELECTRIC POWER PLANTS/ECONOMIC ANALYSIS
Economics of small hydroelectric projects, 4:38342
Economics of low-head hydro: US case studies, 4:38344
WWP view, 4:38341
LOW-HEAD HYDROELECTRIC POWER PLANTS/ECONOMICS
Some basic considerations, 4:38343
What Idaho Power has learned, 4:38340
LOW-HEAD HYDROELECTRIC POWER PLANTS/ENERGY SOURCE DEVELOPMENT
Potential at existing impoundments, 4:38328
LOW-HEAD HYDROELECTRIC POWER PLANTS/ENVIRONMENTAL IMPACTS
Environmental and aesthetic aspects of low-head dams, 4:38348
LOW-HEAD HYDROELECTRIC POWER PLANTS/FINANCING
Economics of small hydroelectric projects, 4:38342
LOW-HEAD HYDROELECTRIC POWER PLANTS/GLOBAL ASPECTS
Impact of the world's energy problems on low-head hydroelectric power, 4:38326
LOW-HEAD HYDROELECTRIC POWER PLANTS/GOVERNMENT POLICIES
Overview of existing Federal programs in low-head hydro, 4:38339
LOW-HEAD HYDROELECTRIC POWER PLANTS/HYDRAULIC TURBINES
Bulb units for low-head hydroelectric generation, 4:38336
Ossberger cross-flow turbine, 4:38335
Straflo turbine, 4:38334
Tube turbines, 4:38337
LOW-HEAD HYDROELECTRIC POWER PLANTS/INLAND WATERWAYS
Potential for hydroelectric development in existing irrigation systems, 4:38330
LOW-HEAD HYDROELECTRIC POWER PLANTS/MEETINGS
Low-head hydro: an examination of an alternative energy source (Seminar at Univ. of Idaho, June 6-7, 1978; 31 papers), 4:38325
LOW-HEAD HYDROELECTRIC POWER PLANTS/PUBLIC RELATIONS
Let's not have another Hells Canyon impasse, 4:38347
LOW-HEAD HYDROELECTRIC POWER PLANTS/SITE SELECTION
Some hydrologic analysis techniques, 4:38329
Studying the Northwest's low-head hydro potential, 4:38331
LP-GAS
See LIQUEFIED PETROLEUM GASES
LUBRICATING OILS
See also WASTE OILS
LUBRICATING OILS/CONSUMPTION RATES
Development of methods to measure the oil consumption of piston engines by means of radionuclide techniques, 4:38304 (KFK-2463)
LUBRICATION/AIR POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
LUBRICATION/LAND POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
LUBRICATION/WATER POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
LUMINESCENCE/MEASURING INSTRUMENTS
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR-3490-1480)
LUNGS/RADIATION DOSES
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
LYMPH NODES/RADIATION DOSES
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
LYMPHOCYTES/CELL PROLIFERATION
Lymphoblastogenesis in response to phytohemagglutinin in radium patients: quantitative aspects and reproducibility (^{226}Ra), 4:39676 (ANL-78-65(Pt.2))
LYMPHOID CELLS
See LYMPHOCYTES

M

MACHINE TOOLS
See also LATHES
MACHINE TOOLS/CONTROL SYSTEMS
Interferometric correction system for a numerically controlled machine (Patent), 4:39265
MACHINE TOOLS/RETROFITTING
Morey mill retrofit, 4:39262 (UCID-18170)
MAGNESIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
Spectral method for determining impurities in anthracite and oil coke, 4:38084
MAGNESIUM/ION EXCHANGE
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
MAGNESIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
MAGNESIUM ALLOYS/ANNEALING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
MAGNESIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
MAGNESIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
MAGNESIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
MAGNESIUM ALLOYS/POSITRON CHANNELING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
MAGNESIUM ALLOYS/PRECIPITATION
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
MAGNESIUM COMPOUNDS/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
MAGNESIUM OXIDES/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MAGNESIUM OXIDES/MICROSTRUCTURE
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MAGNESIUM OXIDES/SEED-SLAG INTERACTIONS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MAGNETIC BAYS
Magnetic substorms and ionospheric storms. A measurement network covering at least the entire Pacific area is seen as the key to the development of complete storm morphologies and a prediction capability. Interim report February 1976-January 1978, 4:39765 (AD-A-057975)
MAGNETIC BAYS/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
MAGNETIC BREMSSTRAHLUNG
See SYNCHROTRON RADIATION
MAGNETIC ENERGY STORAGE EQUIPMENT/DESIGN
Design analysis of annular tunnels for superconductive energy storage using the finite element method, 4:38832
Superconductive energy storage for power systems (Patent), 4:38831
MAGNETIC ENERGY STORAGE EQUIPMENT/MATHEMATICAL MODELS
Security assessment of power systems including energy storage. Progress report, April 1-June 30, 1978, 4:38610 (COO-4206-5)

MAGNETIC ENERGY STORAGE EQUIPMENT/OPERATION
Security assessment of power systems including energy storage. Progress report, April 1-June 30, 1978, 4:38610 (COO-4206-5)
MAGNETIC FIELDS
See also GEOMAGNETIC FIELD
INTERPLANETARY MAGNETIC FIELDS
MAGNETIC FIELDS/BIOLOGICAL EFFECTS
Changes in the electrocardiograms of rats and dogs exposed to dc magnetic fields, 4:39702 (LBL-9085)
MAGNETIC FIELDS/POTENTIAL ENERGY
Nonlinear interaction of tearing modes in highly resistive tokamaks, 4:39992
MAGNETIC FIELDS/SHEAR
Turbulent destabilization and saturation of the universal drift mode in a sheared magnetic field, 4:39995
MAGNETIC FLUX/CONSERVATION LAWS
Astron type equilibrium in the absence of an applied magnetic field, 4:39984
MAGNETIC MIRRORS
See also MFTF DEVICES
MAGNETIC MIRRORS/PLASMA WAVES
Low-frequency fluctuation spectra and associated particle transport in the NASA Lewis Bumpy-Torus plasma, 4:39997 (N-78-30944)
MAGNETIC MIRRORS/PLUGGING
Radio-frequency plugging of a high density plasma, 4:39964 (N-78-27916)
MAGNETIC SPECTROMETERS/CALIBRATION
Precision magnetic measurements by the floating wire analog technique, 4:39458 (LBL-8818)
MAGNETIC STORMS
Compilation of ionlab riometer data for IMS workshop in Hankasalmi, 4:39763 (N-78-28732)
MAGNETIC STORMS/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
MAGNETIC SURVEYS/DATA ANALYSIS
Separation of gravitational and magnetic anomalies for vertical cylindrical bodies, 4:39719
MAGNETIC TAPES/ON-LINE CONTROL SYSTEMS
Stepping motor translator (Patent application), 4:39344
MAGNETIC VORTICES
See MAGNETIC FLUX
MAGNETOGASDYNAMICS/TRANSPORT THEORY
Weak discontinuities in magneto-gasdynamics with finite electrical conductivity, 4:39812
MAGNETOHYDRODYNAMIC CHANNELS
See MHD CHANNELS
MAGNETOHYDRODYNAMIC GENERATORS
See MHD GENERATORS
MAGNETOHYDRODYNAMICS/IDEAL FLOW
Inviscid fluid motions induced by an electric current source. Part I. Preliminary analysis, 4:39811 (N-78-28388)
MAGNETOSPHERE/PLASMA ACCELERATION
Ion acceleration at the earth's bow shock: a review of observations in the upstream region, 4:39738 (LA-UR-79-309)
MAGNETOTAIL/DRIFT INSTABILITY
Lower-hybrid-drift wave turbulence in the distant magnetotail. Interim report, 4:39766 (AD-A-058245)
MAGNETRONS/ELECTRON BEAMS
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
MAGNETRONS/MICROWAVE RADIATION
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
MAGNETRONS/OSCILLATIONS
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341
MAIN SEQUENCE STARS/STAR EVOLUTION
Evolution and explosion of massive stars (Hydrodynamics, convection), 4:39736 (UCRL-82057(Rev.1))
MAIN SEQUENCE STARS/STAR MODELS
Evolution and explosion of massive stars (Hydrodynamics, convection), 4:39736 (UCRL-82057(Rev.1))
MAIZE/DRYING
Apparatus and method for drying seed corn by burning cobs (Patent), 4:39037
MAIZE/PRODUCTION
Energy price levels and the economics of irrigation, 4:39031
MAN
See also A-BOMB SURVIVORS
PATIENTS
PERSONNEL
MAN/WHOLE-BODY COUNTING
Field measurements of radium in the human body (^{226}Ra), 4:39681 (ANL-78-65(Pt.2))
MANATEES/RESOURCE CONSERVATION
The West Indian manatee (Trichechus manatus) in Florida: a summary and analysis of biological, ecological, and administrative problems affecting preservation and restoration of the population. Final report, 4:39609 (PB-285410)
MANGANESE/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
MANGANESE 54/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
MANURES/ANAEROBIC DIGESTION
Operation of an anaerobic digester at the Washington State Dairy Farm, 4:38321
MANURES/BIOCONVERSION
Management of swine manure for the recovery of protein and biogas. Final report, 4:38318 (PB-286722)
MAPS/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
MARAGING STEELS/MASS TRANSFER
Observations of the vacuum arc and metal transfer during vacuum consumable arc remelting, 4:39095 (SAND-79-0922C)
MARAGING STEELS/MELTING
Observations of the vacuum arc and metal transfer during vacuum consumable arc remelting, 4:39095 (SAND-79-0922C)
MARICULTURE
See AQUACULTURE
MARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
MARSHES/CONTAMINATION
Response of a salt marsh to oil spill and cleanup: biotic and erosional effects in the Hackensack Meadowlands, New Jersey. Final report, May 1976-December 1977, 4:38167 (PB-285211)
MASS/MEASURING METHODS
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
MASS TRANSIT SYSTEMS/FLYWHEELS
A limited investigation into regenerative braking and energy storage for mass transit systems. Final report March-October 1977, 4:38834 (PB-284611)
MATHEMATICAL MODELS
See also ATOMIC MODELS
COSMOLOGICAL MODELS
STAR MODELS
STATISTICAL MODELS
Descriptor analysis of economic systems (Using descriptor variable theory), 4:38870 (TID-29393)
MATHEMATICAL MODELS/ENERGY POLICY
Energy policy and mathematics, 4:38917 (ORAU/IEA-79-5(0))
MATHEMATICS
See also STATISTICS
Set-theoretic foundations of data-structure representation, 4:40044
MATHEMATICS/RESEARCH PROGRAMS
Courant Mathematics and Computing Laboratory, New York University. Progress report No. 54, October 1, 1977-September 30, 1978 (Courant Mathematics and Computing Laboratory, New York Univ.), 4:40032 (COO-3077-156)
MEASURING INSTRUMENTS
See also CALORIMETERS
DOSEMETERS
FLOWMETERS
INTERFEROMETERS
RADIATION DETECTORS
RADIATION MONITORS
RADIOMETERS
RADIOMETRIC GAGES
SPECTROMETERS
THERMOCOUPLES
VELOCIMETERS
MEASURING INSTRUMENTS/MARKET
Laboratory instruments, (Brazil). Foreign market survey report, 4:39487 (DIB-78-12-501)
MEASURING INSTRUMENTS/OPTICAL EQUIPMENT
Measurement of adenosine triphosphate (ATP) content in single red blood cells using the firefly bioluminescent reaction, 4:39649 (UR-3490-1480)
MEASURING INSTRUMENTS/SAMPLERS
In Situ Environmental Sampler (IES): descriptive analysis and operating procedures, 4:39507 (SAND-78-1342)
MEAT INDUSTRY/ENERGY CONSERVATION
Energy conservation in the New Zealand meat export industry, 4:39038
MECHANICAL DRAFT COOLING TOWERS/DESIGN
Optimization of design specifications for large dry cooling systems. Final report, June 1975-June 1978, 4:38576 (PB-285924)

MECHANICS
See also FLUID MECHANICS
QUANTUM MECHANICS
MECHANICS/NONLINEAR PROBLEMS
Simplified design methods for nonlinear dynamic mechanical systems, 4:39958 (CONF-790608-1)
MEDICAL CENTERS
See also HOSPITALS
MEDICAL CENTERS/PLANNING
Criteria and standards, for megavoltage radiation therapy installations, 4:39653 (HRP-0018641)
Planning guide for radiologic installations -- fascicle ha, basic concepts, layout considerations, 4:39654 (HRP-0900241)
MELTDOWN
See also CORIUM
MELTDOWN/AFTER-HEAT REMOVAL
In-vessel core debris coolability for large breeder reactors, 4:38800 (GEFR-00415)
MELTDOWN/FISSION PRODUCT RELEASE
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38817 (NUREG/CR-0698)
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38816 (NUREG/CR-0697)
MELTDOWN/HEAT TRANSFER
Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries (LMFBR), 4:38791 (BNL-NUREG-25714)
MELTDOWN/HYDRAULICS
Comparison of measured and calculated average void fraction in volume-boiling pools with inclined boundaries (LMFBR), 4:38791 (BNL-NUREG-25714)
MELTDOWN/MOLTEN METAL-WATER REACTIONS
Steam explosion triggering and efficiency studies (BWR;PWR), 4:38823 (SAND-78-0261C)
MEMBRANE TRANSPORT/HYDROGEN TRANSFER
Heterogeneous catalysis and surface chemistry, 4:39231 (LBL-8975)
MEMORY DEVICES
Set-theoretic foundations of data-structure representation, 4:40044
MEMORY DEVICES/FABRICATION
Radiation-tolerant high-voltage CMOS/MNOS technology, 4:39338 (SAND-78-1523C)
MEMORY DEVICES/RADIATION HARDENING
Radiation-tolerant high-voltage CMOS/MNOS technology, 4:39338 (SAND-78-1523C)
MERCAPTANS
See THIOLS
MERCURY/ADSORPTION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
MERCURY/ENVIRONMENTAL EFFECTS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
MERCURY/ENVIRONMENTAL TRANSPORT
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)
MERCURY/HEALTH HAZARDS
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)
MERCURY/MONITORING
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)
MERCURY/POLLUTION REGULATIONS
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)
MERCURY/PRECIPITATION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
MERCURY/X-RAY FLUORESCENCE ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
MESON RESONANCES
See also CHARMED MESON RESONANCES
CHI-3500 RESONANCES
D RESONANCES
ETA-958 RESONANCES
VECTOR MESONS
MESON RESONANCES/QUARK MODEL
Parton recombination model, 4:39852 (DOE/ER/70004-207)
METACERCARIAE
See LARVAE
METAGALAXY
See UNIVERSE
METAL INDUSTRY
See also MINERAL INDUSTRY
METAL INDUSTRY/ENERGY CONSUMPTION
Energy analysis of zinc production, 4:39034 (PB-283951)
Energy use in the production of primary aluminum, 4:38939
METAL INDUSTRY/INDUSTRIAL WASTES
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
METALS
See also ACTINIDES
RARE EARTHS
METALS/BIOLOGICAL INDICATORS
Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey, 4:39614 (IVL-B-445)
METALS/CREEP
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134
METALS/DEFORMATION
Mechanics of penetration and perforation, 4:39133
METALS/FATIGUE
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134
METALS/ION CHANNELING
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
METALS/MACHINING
Precision machining vs. optical process, 4:39096 (UCRL-82528)
METALS/MEETINGS
Characterization of low cycle high temperature fatigue by the strainrange partitioning method, 4:39134
METALS/PHYSICAL RADIATION EFFECTS
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
METALS/WASTE PROCESSING
Removal of heavy metals from industrial wastewaters using insoluble starch xanthate. Final report, July 1975-June 1976, 4:39351 (PB-283792)
METAMORPHIC ROCKS
See also SHALES
METAMORPHIC ROCKS/FRACTURES
Determination of the location and connectivity of fractures in metamorphic rock with in-hole tracers, 4:39707 (DP-MS-79-11)
METAMORPHIC ROCKS/RADIOACTIVE TRACER LOGGING
Determination of the location and connectivity of fractures in metamorphic rock with in-hole tracers, 4:39707 (DP-MS-79-11)
METEORITES/CHEMICAL COMPOSITION
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
METEORITES/NEUTRON SPECTRA
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
METEOROLOGY
Meteorological aspects of energy use, 4:39534
METEOROLOGY/DATA ACQUISITION
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
METEOROLOGY/DATA ACQUISITION SYSTEMS
Analysis of meteorological conditions during the 1977 Anclote Keys Plume Study. Final report, February-November 1977, 4:39559 (PB-284905)
METEOROLOGY/DATA ANALYSIS
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
METER WAVE RADIATION
See RADIOWAVE RADIATION
METHANATION/CATALYSTS
Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL-8975)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
METHANATION/CHEMICAL REACTION KINETICS
Catalytic synthesis of hydrocarbons, 4:38316 (LBL-8975)
METHANATION/CHEMICAL STATE
Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL-8975)

METHANATION/REACTION INTERMEDIATES
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
METHANE/BIOSYNTHESIS
Operation of an anaerobic digester at the Washington State Dairy Farm, 4:38321
Review of the energy from Marine Biomass Program, 4:38320
METHANE/CHEMICAL REACTION KINETICS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
METHANE/COMBUSTION
Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL-82181)
METHANE/PRODUCTION
ADAM I - methanation pilot plant, 4:38716 (Juel-1433)
METHANE/PUMPING
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
METHANE/SAMPLING
Development of an improved methane sampling system. Open file report, 4:38132 (PB-286006)
METHANE/SYNTHESIS
Catalytic synthesis of hydrocarbons, 4:38316 (LBL-8975)
METHANOL/SYNTHESIS
Advanced methanol synthesis catalysts. Final technical letter report, 4:38323 (PB-286716)
Method for using geothermal energy (Patent), 4:38551
METHYL PHENOLS
See CRESOLS
METHYLBENZENE
See TOLUENE
2-METHYLPROPANE/DATA COMPILATION
Thermodynamic and transport properties of isobutane: a survey of available data, 4:38541 (COO-4051-35)
2-METHYLPROPANE/PHYSICAL PROPERTIES
Thermodynamic and transport properties of isobutane: a survey of available data, 4:38541 (COO-4051-35)
2-METHYLPROPANE/THERMODYNAMIC PROPERTIES
Thermodynamic and transport properties of isobutane: a survey of available data, 4:38541 (COO-4051-35)
MEXICO/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
MFTF DEVICES/ON-LINE CONTROL SYSTEMS
Computer language evaluation for MFTF SCDS, 4:39974 (UCID-18089)
MHD CHANNELS/DESIGN
Design of a single output MHD generator for the USSR U-25 installation, 4:38973 (CONF-781009-)
Studies of MHD generator loading, 4:38977 (CONF-781009-)
MHD CHANNELS/MATERIALS
Materials, 4:39165
MHD CHANNELS/PERFORMANCE TESTING
Studies of diagonal MHD channels at the U-25 facility during duration operation, 4:38976 (CONF-781009-)
MHD CHANNELS/SLAGS
Study of the influence of a slag film on the characteristics of electrodes in the MHD generator channel of the U-02 facility, 4:38974 (CONF-781009-)
MHD GENERATOR AERL MARK VI/MHD CHANNELS
Channel development for coal fired MHD, 4:38975 (CONF-781009-)
MHD GENERATOR AERL MARK VI/PERFORMANCE TESTING
Channel development for coal fired MHD, 4:38975 (CONF-781009-)
MHD GENERATOR CDIF/DESIGN
Capabilities and test program for the component development and integration facility and the coal fired flow facility, 4:38952 (CONF-781009-)
MHD GENERATOR CDIF/ENVIRONMENTAL IMPACTS
Water quality/biological surveillance program for CDIF support , 4:38951 (FE-2524-8)
MHD GENERATOR CDIF/SUPERCONDUCTING MAGNETS
Superconducting magnetohydrodynamic magnet development program, Phase I. Quarterly technical progress report No. 6, October 1-December 31, 1977, 4:38970 (MIT-2295-1)
MHD GENERATOR CFFF/DESIGN
Capabilities and test program for the component development and integration facility and the coal fired flow facility, 4:38952 (CONF-781009-)
MHD GENERATOR U-02/ELECTRIC CONDUCTORS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MHD GENERATOR U-02/ELECTRICAL INSULATORS
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MHD GENERATOR U-02/MATERIALS TESTING
Evaluation of candidate magnetohydrodynamic materials for the U-02 Phase III test, 4:38971 (PNL-2738)
MHD GENERATOR U-02/SLAGS
Study of the influence of a slag film on the characteristics of electrodes in the MHD generator channel of the U-02 facility, 4:38974 (CONF-781009-)
MHD GENERATOR U-25/COMBUSTION CHAMBERS
Studies at the U-25 MHD pilot plant, 1977-1978, 4:38954 (CONF-781009-)
MHD GENERATOR U-25/MHD CHANNELS
Design of a single output MHD generator for the USSR U-25 installation, 4:38973 (CONF-781009-)
Studies at the U-25 MHD pilot plant, 1977-1978, 4:38954 (CONF-781009-)
Studies of diagonal MHD channels at the U-25 facility during duration operation, 4:38976 (CONF-781009-)
MHD GENERATOR U-25/PERFORMANCE TESTING
Results of the first phase tests of the U-25B facility, 4:38953 (CONF-781009-)
Studies at the U-25 MHD pilot plant, 1977-1978, 4:38954 (CONF-781009-)
Studies of diagonal MHD channels at the U-25 facility during duration operation, 4:38976 (CONF-781009-)
MHD GENERATOR U-25/SEED RECOVERY
Studies at the U-25 MHD pilot plant, 1977-1978, 4:38954 (CONF-781009-)
MHD GENERATOR U-25/SUPERCONDUCTING MAGNETS
Observation of voltage fluctuations in a superconducting magnet during MHD power generation, 4:38958 (CONF-780952-24)
MHD GENERATOR UTSI/CONSTRUCTION
Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April-June 1977, 4:38957 (FE-1760-29)
MHD GENERATOR UTSI/DESIGN
Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April-June 1977, 4:38957 (FE-1760-29)
MHD GENERATOR UTSI/MATERIALS TESTING
Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April-June 1977, 4:38957 (FE-1760-29)
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
MHD GENERATOR UTSI/PERFORMANCE TESTING
Experimental investigation on a direct coal-fired MHD generator, 4:38956
MHD GENERATOR UTSI/PLASMA DIAGNOSTICS
Plasma luminosity fluctuations as a diagnostic tool, 4:38984
MHD GENERATOR UTSI/SEED RECOVERY
Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, April-June 1977, 4:38957 (FE-1760-29)
MHD GENERATORS
See also COAL-FIRED MHD GENERATORS
OPEN-CYCLE MHD GENERATORS
Development of the MHD method of energy conversion in the U.S.S.R., 4:38945 (CONF-781009-)
MHD GENERATORS/AIR HEATERS
Materials, 4:39165
Status of air heater development in the United States for MHD systems, 4:38959 (CONF-781009-)
MHD GENERATORS/BOILERS
Materials, 4:39165
MHD GENERATORS/COMBUSTORS
Fuels and combustion, 4:38968
Materials, 4:39165
MHD GENERATORS/ELECTRICAL INSULATORS
Materials, 4:39165
MHD GENERATORS/ELECTRODES
Materials, 4:39165
MHD GENERATORS/LOADING
Studies of MHD generator loading, 4:38977 (CONF-781009-)
MHD GENERATORS/MATERIALS
High temperature materials requirements of the magnetohydrodynamic energy conversion, 4:38972
Materials, 4:39165
MHD GENERATORS/MEETINGS
US-USSR colloquium on magnetohydrodynamic electrical power generation, 4:38944 (CONF-781009-)
MHD GENERATORS/PLASMA DIAGNOSTICS
Development of a technique for measurement of electrical conductivity of plasma in MHD generator channels, 4:38964 (CONF-781009-)

Development of working fluid diagnostics for large MHD generators by means of submillimeter lasers, 4:38981 (CONF-781009-)
Diagnostics of combustion products plasma based on its fluctuation characteristics, 4:38979 (CONF-781009-)
Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry, 4:38980 (CONF-781009-)
Spectroscopic measurements of temperature, electron density, and temperature fluctuations, 4:38965 (CONF-781009-)

MHD POWER PLANTS/AIR HEATERS
High temperature air preheaters for a commercial scale MHD power plant, 4:38961 (CONF-781009-)

MHD POWER PLANTS/COMBUSTION CHAMBERS
Combustion chambers for MHD power plants, 4:38960 (CONF-781009-)

MHD POWER PLANTS/COMPUTER SIMULATION
Open cycle coal fired MHD plants as part of the electric utility system, 4:38946 (CONF-781009-)

MHD POWER PLANTS/EFFICIENCY
Numerical modeling of MHD generator operation in an MHD power plant operating at part load, 4:38955 (CONF-781009-)

MHD POWER PLANTS/LOAD MANAGEMENT
Numerical modeling of MHD generator operation in an MHD power plant operating at part load, 4:38955 (CONF-781009-)

MHD POWER PLANTS/MATHEMATICAL MODELS
Numerical modeling of MHD generator operation in an MHD power plant operating at part load, 4:38955 (CONF-781009-)

MHD POWER PLANTS/RELIABILITY
Influence of component redundancy on the availability of open cycle MHD power plants, 4:38947 (CONF-781009-)

MHD POWER PLANTS/REPAIR
Influence of component redundancy on the availability of open cycle MHD power plants, 4:38947 (CONF-781009-)

MICELLAR-POLYMER FLOODING
See MICROEMULSION FLOODING

MICROBIAL FLORA
See MICROORGANISMS

MICRODOSIMETRY
Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL-78-65(Pt.2))

MICROELECTRONICS/FABRICATION
Electron and ion beam science and technology, 4:39343

MICROEMULSION FLOODING/RESEARCH PROGRAMS
Assessment of potential increased oil production by polymer-waterflood in northern and southern mid-continent oil fields. Progress report for the quarter ending December 31, 1978, 4:38141 (DOE/ET-00026-8)
Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977-September 1978, 4:38138 (BETC-0001-1)

MICROFLORA
See MICROORGANISMS

MICROORGANISMS
See also BACTERIA
YEASTS

MICROORGANISMS/GENE RECOMBINATION
Transposition of plasmid DNA segments specifying hydrocarbon degradation and their expression in various microorganisms, 4:39644

MICROSPHERES/SURFACE COATING
Magnetron sputter coating of microspherical substrates, 4:40018

MICROWAVE AMPLIFIERS
Maser electron cyclotron resonance in vacuum and plasma with REB, 4:39337 (CONF-771035-P2)

MICROWAVE AMPLIFIERS/COMPARATIVE EVALUATIONS
Advances in high-power rf amplifiers, 4:39452 (LA-UR-79-705)

MICROWAVE AMPLIFIERS/DESIGN
Advances in high-power rf amplifiers, 4:39452 (LA-UR-79-705)
Design, fabrication and testing of a CFA for use in the solar power satellite. Final report, 4:38404 (N-78-31143)

MICROWAVE AMPLIFIERS/FEASIBILITY STUDIES
Theory of the cyclotron maser instability, 4:39336 (CONF-771035-P2)

MICROWAVE AMPLIFIERS/PERFORMANCE
Microwave generation in the reflex triode, 4:39424 (CONF-771035-P2)

MICROWAVE POWER TRANSMISSION/MICROWAVE AMPLIFIERS
Design, fabrication and testing of a CFA for use in the solar power satellite. Final report, 4:38404 (N-78-31143)

MICROWAVE RADIATION/COHERENT SCATTERING
Coherent microwave scattering from intense relativistic electron beams: a powerful, tunable source of millimeter and submillimeter radiation, 4:39333 (CONF-771035-P2)
Zero frequency pumped stimulated Raman scattering by an intense relativistic electron beam, 4:39334 (CONF-771035-P2)

MICROWAVE RADIATION/DOSIMETRY
Electromagnetic fields in biological media. I. Dosimetry-a primer on bioelectromagnetics. Final report, 4:39703 (PB-285793)

MICROWAVE RADIATION/POLARIZATION
Microwave emission from pulsed, relativistic e-beam diodes. I. The smooth-bore magnetron, 4:39341

MIDWEST REGION
See also MISSOURI
NEBRASKA

MIDWEST REGION/ENERGY SUPPLIES
Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM-40)

MILITARY EQUIPMENT/ELECTRIC BATTERIES
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)

MILITARY FACILITIES/CO-GENERATION
Cogeneration at Navy bases, Navy energy guidance study. Interim report on phase 1, 4:38566 (AD-A-057405)

MILITARY FACILITIES/INFORMATION SYSTEMS
Development of an Air Force Facilities Energy Information System. Master's thesis, 4:38991 (AD-A-059309)

MILITARY FACILITIES/SOLAR SPACE HEATING
Solar assisted heat pump study for heating of military facilities. Final report, July 1976-November 1977, 4:38415 (AD-A-058626)

MILITARY PERSONNEL/INFORMATION NEEDS
Development of an Air Force Facilities Energy Information System. Master's thesis, 4:38991 (AD-A-059309)

MILK/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)

MILK/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)

MILK/REFRIGERATION
Energy-saving milk production. Using the heat of the milk for heating water, 4:39032

MILLSTONE-2 REACTOR/STEAM GENERATORS
Review of tube support plate analysis for steam generators of Millstone Unit II Nuclear Power Plant, 4:38634 (UCID-17958)

MINERAL INDUSTRY
See also CHEMICAL INDUSTRY
COAL INDUSTRY
METAL INDUSTRY
OIL SHALE INDUSTRY
PETROLEUM INDUSTRY

MINERAL INDUSTRY/CHEMICAL EFFLUENTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)

MINERAL INDUSTRY/POLLUTION CONTROL
Development document for the effluent limitations and guidelines for the ore mining and dressing point source category. Volume I. Final report, 4:38224 (PB-286520)

MINERAL INDUSTRY/WASTE PROCESSING
Development document for the effluent limitations and guidelines for the ore mining and dressing point source category. Volume I. Final report, 4:38224 (PB-286520)

MINERAL INDUSTRY/WATER POLLUTION CONTROL
Development document for the effluent limitations and guidelines for the ore mining and dressing point source category. Volume I. Final report, 4:38224 (PB-286520)

MINERAL RESOURCES/REGIONAL ANALYSIS
Kriging method versus classical statistics in estimating mineral reserves, 4:38889

MINERALS
See also BARITE
CLAYS
FLUORITE
KAOLINITE
MONTMORILLONITE
TRONA
ZEOLITES

MINERALS/CATALYTIC EFFECTS
Coal gasification pilot plant support studies. Project 9030 first quarter report, April 1-June 30, 1978, 4:38063 (FE-2806-1)
Mineral matter effects and catalyst characterization in coal liquefaction. Annual report, October 1977-September 1978, 4:38078 (SAND-79-0505)

MINERALS/CRYSTAL GROWTH
SEM observations and EDX analyses of secondary mineralization in a bituminous coal, 4:38082 (CONF-790418-4)

MINERALS/ECOLOGICAL CONCENTRATION
Tropospheric aerosols, 4:39535

MINERALS/INFRARED SPECTRA
Effects of minerals on coal beneficiation processes. Quarterly report No. 3, April 1-June 30, 1978, 4:38118 (FE-2722-3)

MINERALS/RADIOMETRIC SURVEYS
Determining the water-insoluble residue in potassium salts by gamma surveying, 4:38204
MINERALS/RESEARCH PROGRAMS
A Kentucky Energy Resource Utilization program. Semiannual report, 1 July-31 December 1977, 4:38042 (PB-283796)
MINERALS/SAMPLING
Effects of minerals on coal beneficiation processes. Quarterly report No. 3, April 1-June 30, 1978, 4:38118 (FE-2722-3)
MINERALS/WASTE PRODUCT UTILIZATION
Utilization of coal associated minerals. Quarterly report No. 2, January-March 1978, 4:38086 (FE-2721-2)
MINERALS/X-RAY DIFFRACTION
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR-79/5)
MINERS/EDUCATION
Mine machinery trainer, development and fabrication, 4:38100 (PB-284196)
MINES
See also COAL MINES
URANIUM MINES
MINES/SEALING MATERIALS
A fire retardant froth foam seal topping system for the USBM remote mine sealing system. volume I. Final report Jun 75-Aug 77, 4:38104 (PB-286988)
MINING
See also COAL MINING
SURFACE MINING
UNDERGROUND MINING
MINING/ENVIRONMENTAL EFFECTS
Mining and mineral fuel development in the Montana statewide 208 study area: implications to water quality. Final report, 4:39619 (PB-286217)
MINING/RESEARCH PROGRAMS
A Kentucky Energy Resource Utilization program. Semiannual report, 1 July-31 December 1977, 4:38042 (PB-283796)
MINING EQUIPMENT
See also CONVEYORS
CUTTER LOADERS
MINING EQUIPMENT/CONTROL SYSTEMS
Development trends in remote control systems used in Soviet mining, 4:38096
MINING EQUIPMENT/REMOTE CONTROL
Development trends in remote control systems used in Soviet mining, 4:38096
MINING EQUIPMENT/SIMULATORS
Mine machinery trainer, development and fabrication, 4:38100 (PB-284196)
MINNESOTA/WATER RESOURCES
Codified and uncodified state laws and agency rules and regulations bearing on water and related land resources in Minnesota. Volume 1, 4:38919 (PB-284103)
MIRROR FUSION TEST FACILITY
See MFTF DEVICES
MIRRORS/REFLECTIVITY
X-ray reflectivity vs mirror surface quality, 4:39960 (UCID-18030)
MIRRORS/SURFACE PROPERTIES
Quantitative surface topography determination by Nomarski reflection microscopy I. Theory, 4:39514
MIRRORS (MAGNETIC)
See MAGNETIC MIRRORS
MISSILES/NICKEL-ZINC BATTERIES
Nickel-zinc battery for aircraft and missile applications. Final report 14 Feb 75-14 Feb 78, 4:38845 (AD-A-059295)
MISSOURI/AIR QUALITY
Formation and transport of light-scattering aerosols in the St. Louis urban plume, 4:39575
MISSOURI/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
MISSOURI/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
MISSOURI/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
MISSOURI/THERMAL EFFLUENTS
Regional air pollution study: heat emission inventory. Final report, 4:39585 (PB-284081)
MIXED OXIDE FUEL FABRICATION PLANTS/ACCOUNTING
Application of advanced accountability concepts in mixed oxide fabrication, 4:38228 (WCAP-9104)
Impact of receipt of coprocessed uranium/plutonium on advanced accountability concepts and fabrication facilities. Addendum 1 to application of advanced accountability concepts in mixed oxide fabrication, 4:38229 (WCAP-9104(Add.1))
Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility, 4:38235 (WCAP-9278)
MIXED OXIDE FUEL FABRICATION PLANTS/DATA PROCESSING
Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP-9104(Add.3))
MIXED OXIDE FUEL FABRICATION PLANTS/LEAKS
State of the art survey and measurements of releases within confinement structures from MOX fuel fabrication components, 4:38236 (WCAP-9282)
MIXED OXIDE FUEL FABRICATION PLANTS/LICENSING
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
MIXED OXIDE FUEL FABRICATION PLANTS/MEASURING METHODS
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
MIXED OXIDE FUEL FABRICATION PLANTS/NUCLEAR MATERIALS MANAGEMENT
Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application, 4:38297 (WCAP-9344)
Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation, 4:38298 (WCAP-9345)
State-of-the-art survey of residual holdup in a 200 mt/yr MOX fuel fabrication facility, 4:38296 (WCAP-9128)
MIXED OXIDE FUEL FABRICATION PLANTS/RADIOACTIVE WASTE MANAGEMENT
Review of waste management for a large-scale mixed oxide fuel fabrication facility, 4:38232 (WCAP-9144)
Waste management state-of-the-art review for mixed-oxide fuel fabrication facilities, 4:38234 (WCAP-9200)
MIXED OXIDE FUEL FABRICATION PLANTS/RESEARCH PROGRAMS
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for the period ending December 31, 1977, 4:38237 (WCAP-9293)
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for period ending September 30, 1978, 4:38238 (WCAP-9422)
MIXED OXIDE FUEL FABRICATION PLANTS/SAFEGUARDS
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
Implementation plan for automatic data processing equipment as part of the DYMAC advanced accountability system. Addendum 3 to applications of advanced accountability concepts in mixed oxide fabrication, 4:38231 (WCAP-9104(Add.3))
Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation, 4:38298 (WCAP-9345)
MIXED OXIDE FUEL FABRICATION PLANTS/SHIELDING
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
MIXED OXIDE FUEL FABRICATION PLANTS/THORIUM CYCLE
Impact of uranium-233/thorium cycle on advanced accountability concepts and fabrication facilities. Addendum 2 to application of advanced accountability concepts in mixed oxide fabrication, 4:38230 (WCAP-9104(Add.2))
MOBIL M-GASOLINE PROCESS
See also GASOLINE
SYNTHETIC FUELS
MOBIL M-GASOLINE PROCESS/ECONOMICS
Economics of gasoline production from underground coal gasification via Mobil-M process, 4:38047 (CONF-790405-12)
MODELS (ATOMIC)
See ATOMIC MODELS
MODELS (COSMOLOGICAL)
See COSMOLOGICAL MODELS
MODELS (MATHEMATICAL)
See MATHEMATICAL MODELS
MODELS (STATISTICAL)
See STATISTICAL MODELS
MOLECULAR BEAMS/PHOTOIONIZATION
Photoionization mass spectrometric studies of selected compounds in a molecular beam, 4:39793 (LA-7727-T)

MOLECULAR IONS/DISSOCIATION
Effects of the Coulomb explosion on the transmission of molecular ions through a tandem, 4:39771 (LA-7445-C)
MOLECULAR ORBITAL MODEL
See ATOMIC MODELS
MOLECULES
MOLECULAR STRUCTURE/CHEMICAL BONDS
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
MOLECULAR STRUCTURE/COMPUTER CALCULATIONS
Development of basis sets for molecular calculations. Comparison of tetrahedral Gaussian lobe functions and Cartesian Gaussian basis sets, 4:39804
MOLECULAR STRUCTURE/CORRELATIONS
Graph-theoretical analysis of structure--property and structure--activity correlations, 4:39805
MOLECULE COLLISIONS
See also ION-MOLECULE COLLISIONS
MOLECULE COLLISIONS/ENERGY TRANSFER
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978-May 31, 1979 (Summaries of research activities at Univ., Missouri), 4:39791 (COO-2718-7)
MOLECULES
See also POLYATOMIC MOLECULES
MOLECULES/HARMONIC OSCILLATOR MODELS
Analytic coherent states for generalized potentials, 4:39802 (LA-UR-79-218)
MOLLUSCS/ENVIRONMENTAL EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)
MOLLUSCS/IMPINGEMENT
Cooling Systems Program, 4:39621 (ORNL-5508)
MOLLUSCS/TEMPERATURE EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)
MOLTEN METAL-WATER REACTIONS/SIMULATION
Steam explosion triggering and efficiency studies (BWR;PWR), 4:38823 (SAND-78-0261C)
MOLTEN SALTS/CORROSIVE EFFECTS
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
MOLTEN SALTS/LATENT HEAT STORAGE
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
MOLTEN SALTS/PERFORMANCE
Nuclear performance of molten salt fusion-fission symbiotic systems for catalyzed DD and DT reactors, 4:40010 (ORNL/TM-6560)
MOLYBDENUM/CATALYTIC EFFECTS
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
MOLYBDENUM/POISONING
Chemical poisoning in heterogeneously catalyzed reactions, 4:39239 (LBL-8975)
MOLYBDENUM/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
MOLYBDENUM ALLOYS/CRACKS
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
MOLYBDENUM ALLOYS/FRACTURE PROPERTIES
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
MOLYBDENUM ALLOYS/SORPTIVE PROPERTIES
Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM-2600(TR))
MOLYBDENUM ALLOYS/STRESS ANALYSIS
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
MONITORS (REACTOR)
See REACTOR CONTROL SYSTEMS
MONOCHROMATORS/PERFORMANCE
Separated function focusing monochromator system for synchrotron radiation, 4:39463
MONTANA/ENERGY SOURCE DEVELOPMENT
Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB-283809)
MONTANA/MINING
Mining and mineral fuel development in the Montana statewide 208 study area: implications to water quality. Final report, 4:39619 (PB-286217)
MONTE CARLO METHOD/COMPUTER CALCULATIONS
Monte Carlo study of an ordering alloy on an fcc lattice, 4:39949
MONTMORILLONITE/SORPTIVE PROPERTIES
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
MOON/MAGNETIC FIELDS
Crustal evolution inferred from apollo magnetic measurements, 4:39760 (N-78-32029)
MORPHOLOGICAL CHANGES/RADIOINDUCTION
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
MORPHOLOGY
See MORPHOLOGICAL CHANGES
MULE DEER
See DEER
MULTIPARTICLE SPECTROMETERS/PERFORMANCE
MPS configuration and performance characteristics, 4:39433 (BNL-25311)
MULTIWIRE PROPORTIONAL CHAMBERS/BEAM MONITORING
Computed tomographic reconstruction of beam profiles with a multi-wire chamber, 4:39459 (LBL-8947)
MUNICIPAL WASTES/ENERGY RECOVERY
Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
MUNICIPAL WASTES/WASTE PROCESSING
Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
MUON PAIRS/PARTICLE PRODUCTION
Anomalous e^+e^- and $\mu^+\mu^-$ events produced in e^+e^- annihilation (Differential cross sections), 4:39846
MUON-PROTON INTERACTIONS/EXCLUSIVE INTERACTIONS
Exclusive vector-meson production in muon-proton scattering, 4:39816
MUON-PROTON INTERACTIONS/PARTICLE PRODUCTION
Exclusive vector-meson production in muon-proton scattering, 4:39816
MUONS
See also MUONS PLUS
MUONS/MAGNETIC MOMENTS
Corrections to the sixth-order anomalous magnetic moment of the muon, 4:39845
MUONS PLUS/RADIATIVE DECAY
Upper limit for the decay $\mu^+ \rightarrow e^+\gamma$, 4:39818
MUSSELS
See MOLLUSCS
MUTAGEN SCREENING/SPERMATOZOA
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
MX DEVICES
See MFTF DEVICES

N

NAMAFJALL GEOTHERMAL FIELD/GEOLOGY
Geothermal power plants of Iceland: a technical survey of existing and planned installations, 4:38539 (COO-4051-38)
NAPHTHENES
See CYCLOALKANES
NATIONAL ACCELERATOR LABORATORY
See FERMILAB ACCELERATOR
NATIONAL ENERGY ACT
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
NATIONAL ENERGY ACT/COMPLIANCE
Analysis and update of roles and responsibilities derived from Executive Order 12003 and related authorities, 4:39008 (DOE/TIC-10064)
Briefings related to Executive Order 12003 and the National Energy Act, 4:38900 (DOE/TIC-10065)
Recommended changes to Executive Order 12003 and related authorities, 4:38901 (DOE/TIC-10066)
NATIONAL ENERGY PLAN/COMPLIANCE
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
NATIONAL ENERGY PLAN/REGULATIONS
Managerial plan: Executive Order 12003 and the National Energy Act (proposed). Synopsis, 4:38899 (DOE/TIC-10062)
NATIONAL ENERGY PLAN/SOCIO-ECONOMIC FACTORS
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
NATURAL DRAFT COOLING TOWERS/ENVIRONMENTAL EFFECTS
Chalk point cooling tower project: cooling tower effects on crops and soils. preoperational report. Report for April 1973-April 1975, 4:38593 (PB-284075)

Chalk point cooling tower project: cooling tower effects on crops and soils. Preoperational report, appendix. Report for April 1973-April 1975, 4:38594 (PB-284076)
Chalk point cooling tower project: cooling tower effects on crops and soils. Postoperational report No. 1, Volume 1. Final report, May 1975-April 1976, 4:38595 (PB-284077)
Chalk point cooling tower project: cooling tower effects on crops and soils. postoperational report no. 1, volume 2. Final report May 1975-April 1976, 4:38596 (PB-284078)
Chalk point cooling tower project: cooling tower effects on crops and soils. post operational report no. 2. Final report FY 1977, 4:38597 (PB-284094)
Chalk point cooling tower project: effects of simulated saline cooling tower drift on woody species. Master's thesis, 4:38598 (PB-284214)

NATURAL GAS
See also LIQUEFIED NATURAL GAS

NATURAL GAS/CHARGES
The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB-283975)

NATURAL GAS/COST
Oil and gas replacement cost: development and production. Volume 1. Discussion of methodology, exhibits, and projections. Final report, 4:38158 (DOE/TIC-10078)

NATURAL GAS/DEHYDRATION
Natural gas dehydration with solid desiccant, 4:38176 (CONF-7611113-)

NATURAL GAS/MANAGEMENT
Aspects of public utility regulation. Staff research report, 4:38920 (PB-284145)

NATURAL GAS/PRODUCTION
Analysis of the structural parameters that influence gas production from the Devonian shale. Volume 1. Executive Summary and Task Reports. Annual progress report, 4:38177 (ORO-5194-2(Vol.1))

NATURAL GAS DEPOSITS/EXPLORATION
Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134

NATURAL GAS DEPOSITS/GEOLOGICAL SURVEYS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135

NATURAL GAS DEPOSITS/GEOPHYSICAL SURVEYS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135

NATURAL GAS DEPOSITS/HYDRAULIC FRACTURING
LLL gas stimulation program. Quarterly progress report, October-December 1978, 4:38181 (UCRL-50036-78-4)
Some results from continuum mechanics analyses of the hydraulic fracturing process, 4:38182 (UCRL-81707)

NATURAL GAS DISTRIBUTION SYSTEMS
See also PIPELINES

NATURAL GAS DISTRIBUTION SYSTEMS/PIPELINES
Boring proves exciting way to cross river, 4:38185 (CONF-7611113-)
Flexible connectors, 4:38184 (CONF-7611113-)

NATURAL GAS GATHERING SYSTEMS
See NATURAL GAS DISTRIBUTION SYSTEMS

NATURAL GAS WELLS/ELECTRICAL SURVEYS
Frequency distortions in a multistrand cable during electrical surveying of wells, 4:38136

NATURAL GAS WELLS/HYDRAULIC FRACTURING
Enhanced gas recovery program. Third annual report, October 1977-September 1978, 4:38180 (SAND-79-0056)

NAVAL RESEARCH LABORATORY/ENERGY POLICY
U.S. Navy energy plan and program, 1978. Technical report, 4:38914 (AD-A-058054)

NEAR ULTRAVIOLET RADIATION
(Wavelength range 4000-2000 A.)

NEAR ULTRAVIOLET RADIATION/BIOLOGICAL EFFECTS
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

NEAR ULTRAVIOLET RADIATION/CARCINOGENESIS
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

NEBRASKA/GEOTHERMAL EXPLORATION
Geothermal exploration methods and results: inland states, 4:38519 (LA-UR-79-655)

NEBULAE/EMISSION SPECTRA
Observations of the 51.8 micron (O III) emission line in Orion, 4:39732 (N-78-28024)

NEBULAE/POLARIZATION
Far infrared polarization of the Kleinmann-Low nebula in orion, 4:39733 (N-78-28025)

NEODYMIUM 142 TARGET/OXYGEN 16 REACTIONS
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912

NEODYMIUM LASERS/FLUCTUATIONS
Fluctuations of the energy and duration of Q-switched picosecond YAG:Nd^{3+} laser radiation, 4:39307

NEODYMIUM LASERS/LASER MATERIALS
Glasses suitable for laser application (Patent), 4:39300

NEON/ELECTRON-ATOM COLLISIONS
Theoretical cross sections for ionization of metastable excimers Ne^*_2 and Ar^*_2 by electron impact, 4:39797

NEON/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb $\rightarrow \pi^{+-}$, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)

NEOPENTANE
See 2-2-DIMETHYLPROPANE

NEOPLASMS
See also CARCINOMAS
SARCOMAS

NEOPLASMS/RADIOINDUCTION
Atomic Bomb Casualty Commission. Annual report, 1 July 1973-30 June 1974, 4:39660 (ABCC-TR-73-74)
Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL-78-65(Pt.2))
Recent cases of radium-induced malignancy, 4:39671 (ANL-78-65(Pt.2))
Suppression of transformed foci, induced by alpha radiation of C3H 10T1/2 cells, by untransformed cells, 4:39685 (ANL-78-65(Pt.2))

NEOPLASMS/RADIOTHERAPY
Clinical and preclinical aspects, of bone tumors and soft tissue sarcomas. Special listing, 4:39655 (NTISUB/D/294-009)
Radiotherapy, nuclear medicine, radiologic diagnosis and related techniques. Special listing, 4:39656 (NTISUB/D/294-011)

NEPTUNIUM/ADSORPTION
Adsorption of neptunium and plutonium on metal phosphites, 4:38252 (MLM-2595)

NEPTUNIUM/ENVIRONMENTAL EFFECTS
Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc, 4:39601 (CONF-781105-100)

NEPTUNIUM/PHOTOCHEMICAL REACTIONS
Photochemistry of the actinides, 4:39253 (CONF-790415-21)

NEPTUNIUM 239/METABOLISM
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)

NEUTRINO-DEUTERON INTERACTIONS/QUASI-ELASTIC SCATTERING
Neutrino-deuterium reactions in the 7-foot bubble chamber (Strangeness, CVC theory, V-A theory), 4:39819 (BNL-24848)

NEUTRINO-NEUTRON INTERACTIONS/EXCLUSIVE INTERACTIONS
Neutrino-deuterium reactions in the 7-foot bubble chamber (Strangeness, CVC theory, V-A theory), 4:39819 (BNL-24848)

NEUTRINO-NUCLEON INTERACTIONS
See also ANTINEUTRINO-NUCLEON INTERACTIONS
NEUTRINO-NEUTRON INTERACTIONS
NEUTRINO-PROTON INTERACTIONS

NEUTRINO-NUCLEON INTERACTIONS/CHARGED-CURRENT INTERACTIONS
Recent results on neutrino reactions (Review), 4:39820 (COO-3071-237)

NEUTRINO-NUCLEON INTERACTIONS/DEEP INELASTIC SCATTERING
Model-independent determination of hadronic neutral-current couplings, 4:39848

NEUTRINO-NUCLEON INTERACTIONS/INCLUSIVE INTERACTIONS
Recent results on neutrino reactions (Review), 4:39820 (COO-3071-237)

NEUTRINO-NUCLEON INTERACTIONS/NEUTRAL-CURRENT INTERACTIONS
Model-independent determination of hadronic neutral-current couplings, 4:39848

NEUTRINO-NUCLEON INTERACTIONS/PARTICLE PRODUCTION
Search for short-lived particles in high-energy neutrino interactions identified using a hybrid emulsion-spark-chamber arrangement, 4:39821

NEUTRINO-PROTON INTERACTIONS/ELASTIC SCATTERING
Model-independent determination of hadronic neutral-current couplings, 4:39848

NEUTRINO-PROTON INTERACTIONS/FRAGMENTATION
Hadronic fragmentation initiated by pointlike probes, 4:39849

NEUTRINO-PROTON INTERACTIONS/INCLUSIVE INTERACTIONS
Hadronic fragmentation initiated by pointlike probes, 4:39849

NEUTRINO-PROTON INTERACTIONS/NEUTRAL-CURRENT INTERACTIONS
Model-independent determination of hadronic neutral-current couplings, 4:39848
NEUTRON ABSORBERS/PERFORMANCE TESTING
BICM-2 instrumented neutron absorber experiment, 4:38754 (HEDL-TME-78-103)
NEUTRON BEAMS/FISSION
Neutron physics at LASL, 4:39378
NEUTRON BEAMS/TOTAL CROSS SECTIONS
Neutron physics at LASL, 4:39378
NEUTRON CAPTURE
See NEUTRON BEAMS
NEUTRON FLUX/RADIATION MONITORING
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON MONITORS/DATA ACQUISITION SYSTEMS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON MONITORS/DATA ANALYSIS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON MONITORS/OPERATION
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON MONITORS/PERFORMANCE
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON REACTIONS/CAPTURE
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV (Data compilation, cross sections, angular distributions), 4:39922 (LA-UR-78-3062)
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
Summary documentation for ^{242}Pu (10 keV to 20 MeV), 4:39921 (LA-7663-MS)
NEUTRON REACTIONS/CHARGE-EXCHANGE REACTIONS
Summary documentation for ^{3}He (1 keV to 1 MeV), 4:39882 (LA-7663-MS)
NEUTRON REACTIONS/COMPOUND-NUCLEUS REACTIONS
Doppler effect measurements on solid and liquid Sn (24 keV), 4:39910 (CONF-790602-41)
Summary documentation for ^{6}Li (10 eV to 550 keV), 4:39892 (LA-7663-MS)
Summary documentation for ^{10}B (1 keV to 1 MeV), 4:39893 (LA-7663-MS)
NEUTRON REACTIONS/ELASTIC SCATTERING
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV (Data compilation, cross sections, angular distributions), 4:39922 (LA-UR-78-3062)
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, total and differential cross sections), 4:39909 (ANL/NDM-46)
Summary documentation for ^{1}H (10^{-5} eV to 20 MeV), 4:39881 (LA-7663-MS)
Summary documentation for ^{3}He (1 keV to 1 MeV), 4:39882 (LA-7663-MS)
Summary documentation for ^{4}He (10^{-11} to 20 MeV), 4:39883 (LA-7663-MS)
NEUTRON REACTIONS/FAST FISSION
Absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu at 13.9 and 14.6 MeV, 4:39927
Calculation of prompt fission neutron spectra, 4:39917 (LA-7722-PR)
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV (Data compilation, cross sections, angular distributions), 4:39922 (LA-UR-78-3062)
Fission product yields from 6-9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis, 4:39926 (AD-A-059327)
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
NEUTRON REACTIONS/FISSION
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
Review of the microscopic cross sections for the americium isotopes in the resolved resonance region (0.5 eV to 10 keV), 4:39923 (UCRL-81909)
Summary documentation for ^{242}Pu (10 keV to 20 MeV), 4:39921 (LA-7663-MS)
NEUTRON REACTIONS/INELASTIC SCATTERING
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV (Data compilation, cross sections, angular distributions), 4:39922 (LA-UR-78-3062)
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, total and differential cross sections), 4:39909 (ANL/NDM-46)
NEUTRON REACTIONS/INFORMATION NEEDS
Nuclear power and neutron physics, 4:39941 (INIS-mf-4508)
NEUTRON REACTIONS/LECTURES
Third international school on neutron physics (Alushta, April 19-30, 1978), 4:39880
NEUTRON REACTIONS/NEUTRON SPECTRA
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
NEUTRON REACTIONS/NUCLEAR DATA COLLECTIONS
Summary documentation of LASL nuclear data evaluations for ENDF/B-V, 4:39878 (LA-7663-MS)
NEUTRON REACTIONS/PICKUP REACTIONS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
New measurement of the ^{6}Li(n,α)T cross section (3 to 800 keV), 4:39897
NEUTRON REACTIONS/THERMAL FISSION
Energy dissipation in ^{235}U(n/sub th/,f) (Energy losses, potential energy), 4:39918 (ORO-5126-62)
NEUTRON REACTIONS/TOTAL CROSS SECTIONS
Doppler effect measurements on solid and liquid Sn (24 keV), 4:39910 (CONF-790602-41)
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, total and differential cross sections), 4:39909 (ANL/NDM-46)
Summary documentation for ^{1}H (10^{-5} eV to 20 MeV), 4:39881 (LA-7663-MS)
Summary documentation for ^{3}He (1 keV to 1 MeV), 4:39882 (LA-7663-MS)
Summary documentation for ^{4}He (10^{-11} to 20 MeV), 4:39883 (LA-7663-MS)
NEUTRON SOURCES
(Excludes reactors even when used as neutron sources.)
NEUTRON SOURCES/CALIBRATION
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON SOURCES/NEUTRON FLUX
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
NEUTRON STARS/PION CONDENSATION
Many-particle theory of nuclear system with application to neutron-star matter and other systems. Semiannual status report, February. 1978-July 1978, 4:39930 (N-78-31019)
NEUTRON TRANSPORT/INFORMATION NEEDS
Nuclear power and neutron physics, 4:39941 (INIS-mf-4508)
NEUTRON TRANSPORT/LECTURES
Third international school on neutron physics (Alushta, April 19-30, 1978), 4:39880
NEUTRON TRANSPORT THEORY/RESEARCH PROGRAMS
Transport and reactor theory. Progress report, October 1-December 31, 1978, 4:38724 (LA-7704-PR)
NEUTRONS/BOUND STATE
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, Σ-^{12}C, Σ-n bound state), 4:39822 (BNL-25879)
NEVADA TEST SITE/CACTI
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
NEVADA TEST SITE/SHRUBS
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
NEVADA TEST SITE/TREES
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
NEW HAMPSHIRE/GEOTHERMAL EXPLORATION
Geothermal exploration methods and results: inland states, 4:38519 (LA-UR-79-665)
NEW MEXICO/PETROLOGY
Structural petrology of undeformed and experimentally deformed halite samples from USERDA site No. 7 and No. 9, 4:39726 (SAND-78-7076)
NEW YORK
See also NEW YORK CITY
NEW YORK/ENERGY SOURCE DEVELOPMENT
Attracting OCS related onshore facilities and activities: an assessment of prospects for New York state and their economic benefits, 4:38866 (PB-285197)
Marine related activities: an assessment of the economic impacts of OCS energy development, 4:38867 (PB-285198)

NEW YORK/GEOTHERMAL EXPLORATION
Geothermal exploration methods and results: inland states, 4:38519 (LA-UR-79-665)
NEW YORK CITY/RESPIRATORY SYSTEM DISEASES
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO-2874-46)
NEW ZEALAND/ENERGY CONSERVATION
Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
NEW ZEALAND/ENERGY POLICY
Energy scenarios: details of supplementary studies, 4:38913
NEW ZEALAND/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
NEW ZEALAND/HEATING SYSTEMS
Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
NEW ZEALAND/MEAT INDUSTRY
Energy conservation in the New Zealand meat export industry, 4:39038
NEW ZEALAND/RENEWABLE ENERGY SOURCES
Energy scenarios: details of supplementary studies, 4:38913
NEW ZEALAND/RESIDENTIAL BUILDINGS
Energy in new housing: economic and technical aspects of alternative sources of supply, 4:38940
NEW ZEALAND/TEXTILE INDUSTRY
Energy use in the New Zealand textile industry, 4:39030
NEW ZEALAND/TRANSPORTATION SECTOR
Energy in transport. Volume 1. Data, 4:38941
NICKEL/CATALYTIC EFFECTS
Catalytic hydrogenation process, 4:39246
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
NICKEL/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
NICKEL/CHEMICAL STATE
Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL-8975)
NICKEL/CORROSION
Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978-31 May 1979, 4:39091 (COO-2960-3)
NICKEL/DISLOCATIONS
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
NICKEL/ION CHANNELING
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
NICKEL/ION COLLISIONS
Impact-parameter dependence of K-vacancy production in Cu-Ni collisions, 4:39799
NICKEL/IONIZATION
Impact-parameter dependence of K-vacancy production in Cu-Ni collisions, 4:39799
NICKEL/MICROSTRUCTURE
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
NICKEL/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
NICKEL/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
NICKEL/NONDESTRUCTIVE TESTING
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
NICKEL/PHYSICAL RADIATION EFFECTS
Application of ion channeling to radiation damage studies, 4:39168 (SAND-79-0497C)
NICKEL/SORPTIVE PROPERTIES
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
Theoretical studies of nickel clusters and chemisorption of hydrogen, 4:39151
NICKEL/SURFACE PROPERTIES
Theoretical studies of nickel clusters and chemisorption of hydrogen, 4:39151
NICKEL/VACANCIES
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
NICKEL 58 TARGET/TRITON REACTIONS
Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
NICKEL 59/ENERGY LEVELS
Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
NICKEL 64 REACTIONS/COMPOUND-NUCLEUS REACTIONS
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{164}Er yrast cascade to spin 36, 4:39912
NICKEL 64 TARGET/TRITON REACTIONS
Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
NICKEL 65/ENERGY LEVELS
Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
NICKEL ALLOYS
See also CHROMIUM-NICKEL STEELS
NICKEL BASE ALLOYS
NICKEL ALLOYS/CATALYTIC EFFECTS
Fundamental factors in catalyzed carbon-gas reactions, 4:38064 (LBL-8975)
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
NICKEL ALLOYS/CRACKS
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
NICKEL ALLOYS/FRACTURE PROPERTIES
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
NICKEL ALLOYS/STRESS ANALYSIS
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
NICKEL BASE ALLOYS
See also ALLOY-IN-100
INCONEL 671
INCONEL ALLOYS
High temperature materials requirements in reforminng of gaseous hydrocarbons with HTR heat, 4:39143
NICKEL BASE ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
NICKEL COMPLEXES/ELECTRIC CONDUCTIVITY
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)
NICKEL COMPLEXES/SYNTHESIS
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)
NICKEL SULFIDES/OXIDATION
AES study of oxidation of surface and bulk sulfides of Ni, 4:39150
NICKEL-CADMIUM BATTERIES/BIBLIOGRAPHIES
Battery literature, search, bibliography and abstracts. Volume I, 4:38840 (N-77-74765)
NICKEL-CADMIUM BATTERIES/PERFORMANCE TESTING
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
NICKEL-ZINC BATTERIES/ANODES
Observations of an operating zinc-pore electrode. Interim technical report, 4:38848 (AD-A-059300)
NICKEL-ZINC BATTERIES/BATTERY SEPARATORS
Galvanic cell having rechargeable zinc electrode (Patent; mechanical-chemical approach), 4:38853
NICKEL-ZINC BATTERIES/PERFORMANCE
Nickel-zinc battery for aircraft and missile applications. Final report 14 Feb 75-14 Feb 78, 4:38845 (AD-A-059295)
NIMONIC 90/FATIGUE
Low cycle fatigue behavior of Nimonic 90 at elevated temperature, 4:39139
NIOBIUM/CHEMICAL BONDS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
NIOBIUM/CRYSTAL FIELD
Self-consistent mixed-basis approach to the electronic structure of solids, 4:39159
NIOBIUM/CRYSTAL-PHASE TRANSFORMATIONS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
NIOBIUM/ELECTRONIC STRUCTURE
Self-consistent mixed-basis approach to the electronic structure of solids, 4:39159

NIOBIUM/ENERGY-LEVEL DENSITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM/FERMI LEVEL
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
NIOBIUM/SPUTTERING
Sputtering of two-phase polycrystalline metals, 4:39777
NIOBIUM/SUPERCONDUCTIVITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM 90/ENERGY LEVELS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
NIOBIUM ALLOYS
See also NIOBIUM BASE ALLOYS
NIOBIUM ALLOYS/CRYSTAL STRUCTURE
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341-3)
NIOBIUM ALLOYS/CRYSTAL-PHASE TRANSFORMATIONS
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341-3)
NIOBIUM ALLOYS/SORPTIVE PROPERTIES
Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM-2600(TR))
NIOBIUM BASE ALLOYS/CHEMICAL BONDS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
NIOBIUM BASE ALLOYS/CRYSTAL-PHASE TRANSFORMATIONS
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. II. Bonding, electronic charge distributions, and structural transformation, 4:39157
NIOBIUM BASE ALLOYS/ENERGY-LEVEL DENSITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM BASE ALLOYS/FERMI LEVEL
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM BASE ALLOYS/MECHANICAL PROPERTIES
Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976-September 30, 1977 (Nb_3 Sn conductor testing), 4:39269 (BNL-50961)
NIOBIUM BASE ALLOYS/SUPERCONDUCTIVITY
Electronic properties of Nb_3Ge and Nb_3Al from self-consistent pseudopotentials. I. Band structure and density of states, 4:39156
NIOBIUM HYDRIDES/CRYSTAL-PHASE TRANSFORMATIONS
Modulated ordering Nb-H alloys, 4:39175 (CONF-790341-4)
NIOBIUM HYDRIDES/PHASE DIAGRAMS
Structure of the λ-phases of niobium deuterium, 4:39174 (CONF-790341-3)
NIOBIUM OXIDES/SPUTTERING
Sputtering of two-phase polycrystalline metals, 4:39777
NITRATES/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
NITRATES/CORROSIVE EFFECTS
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
NITRATES/ENVIRONMENTAL TRANSPORT
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
NITRATES/LATENT HEAT STORAGE
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
NITRIC OXIDE/MOLECULE-MOLECULE COLLISIONS
Carbon reaction studied by crossed molecular beams), 4:39786
NITRIC OXIDE/QUANTITATIVE CHEMICAL ANALYSIS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)
NITRILES/CHEMICAL REACTIONS
Catalytic hydrogenation process, 4:39246
NITRITES/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
NITRITES/CORROSIVE EFFECTS
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
NITRITES/LATENT HEAT STORAGE
Corrosion in molten salts used for solar thermal storage applications, 4:38507 (SAND-79-0246C)
NITROGEN/ADSORPTION
Interactions of gases with coal: structural inferences, 4:38081 (CONF-790415-26)
NITROGEN/CHARGED-PARTICLE TRANSPORT
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
NITROGEN/DIELECTRIC PROPERTIES
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA-7445-C)
NITROGEN/ENVIRONMENTAL EFFECTS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
NITROGEN/ION-MOLECULE COLLISIONS
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu (Preliminary cross sections, electron pickup and loss, 3.4 to 8.5 MeV/amu), 4:39795 (LBL-8932)
NITROGEN/REMOVAL
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)
NITROGEN/TRANSLOCATION
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
NITROGEN 13/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
NITROGEN 14/MULTIPOLE TRANSITIONS
Inelastic electron scattering from ^{14}N at 180°, 4:39890
NITROGEN 14 TARGET/DEUTERON REACTIONS
Excitation function for ^{15}O production via the ^{14}N (d,n)^{15}O reaction (cross sections, 0.6 to 14.35 MeV), 4:39898
NITROGEN 14 TARGET/ELECTRON REACTIONS
Inelastic electron scattering from ^{14}N at 180°, 4:39890
NITROGEN DIOXIDE/ADSORPTION
Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977-November 30, 1978, 4:39551 (ORO-5592-2)
NITROGEN DIOXIDE/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
NITROGEN DIOXIDE/ENVIRONMENTAL EFFECTS
Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977-15 April 1978, 4:39547 (N-78-27687)
NITROGEN DIOXIDE/QUANTITATIVE CHEMICAL ANALYSIS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)
NITROGEN OXIDES
See also NITRIC OXIDE
NITROGEN DIOXIDE
NITROUS OXIDE
NITROGEN OXIDES/AIR POLLUTION ABATEMENT
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)
NITROGEN OXIDES/AIR POLLUTION CONTROL
Catalytic control of NO/sup x/ demonstration. Final report, 4:39088 (PB-284095)
Control of nitrogen oxides from stationary source effluents (Patent), 4:39356
Method for removing nitrogen oxides from nitrogen oxide-containing gases (Patent), 4:39353
Process and apparatus for controlled recycling of combustion gases (Patent), 4:39349
Process for continuously regenerating a degraded catalyst used for removing nitrogen oxides from exhaust gas (Patent), 4:39355
Separating gaseous nitrogen oxides from other gases by paramagnetic separation in a liquid media (Patent), 4:39354
NITROGEN OXIDES/BIOLOGICAL EFFECTS
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)
NITROGEN OXIDES/ENVIRONMENTAL TRANSPORT
Comparison of particulate and gaseous material within and above the mixed layer, 4:39540 (BNL-25002)
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
NITROGEN OXIDES/INVENTORIES
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)

NITROUS OXIDE/ENVIRONMENTAL EFFECTS
Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977-15 April 1978, 4:39547 (N-78-27687)
NONDESTRUCTIVE ANALYSIS/MANUALS
Savannah River Plant Californium-252 Shuffler software manual (ASSAY; TEST), 4:38291 (LA-7717-M)
NORTH CAROLINA/ENERGY SHORTAGES
An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974-30 June 1977, 4:38938 (PB-284018)
NORTH CAROLINA/MAGNETIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle, 4:38218 (GJBX-57(79)(Vol.2)(Knoxville))
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Charlotte NI 17-2 Quadrangle, 4:38217 (GJBX-57(79)(Vol.2)(Charlotte))
NORTH CAROLINA/RADIOMETRIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle, 4:38218 (GJBX-57(79)(Vol.2)(Knoxville))
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Charlotte NI 17-2 Quadrangle, 4:38217 (GJBX-57(79)(Vol.2)(Charlotte))
NORTH CAROLINA/SPEED LIMIT
An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974-30 June 1977, 4:38938 (PB-284018)
NORTH DAKOTA/ENERGY SOURCE DEVELOPMENT
Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB-283809)
NORTH DAKOTA/ENERGY SUPPLIES
Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM-40)
NORTHERN IRELAND
See UNITED KINGDOM
NOZZLES/CRACKS
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf-4506)
Finite element analysis of crack propagation problems for the fracture mechanics evaluation of reactor vessel nozzle junction, 4:38632 (INIS-mf-4506)
NOZZLES/FRACTURE PROPERTIES
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)
NOZZLES/STRESS ANALYSIS
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf-4506)
NPR REACTOR
See N-REACTOR
N-REACTOR/PERSONNEL
Radiation exposure usage accountability and impact with respect to ALAP (ALARA) analysis, 4:38785 (UNI-1197)
NSLS/SPECIFICATIONS
Design status of the 2.5 GeV National Synchrotron Light Source x-ray ring, 4:39468 (BNL-25774)
NSLS/VACUUM SYSTEMS
Vacuum system for National Synchrotron Light Source, 4:39330
NUCLEAR ENERGY/RESEARCH PROGRAMS
Reference data: a basic plan for research and development, 4:38509
NUCLEAR EVAPORATION
See EVAPORATION MODEL
NUCLEAR EXPLOSION DETECTION/DATA PROCESSING
Seismic monitoring: a unified system for research and verifications, 4:39714 (UCRL-52665)
NUCLEAR EXPLOSION DETECTION/SEISMIC DETECTION
Relationships between noise and mb bias applied to seismic station site selection and performance evaluation. Technical report, 4:39525 (AD-A-058227)
NUCLEAR EXPLOSIONS/GAMMA RADIATION
The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report, 4:39522 (AD-A-059705)
NUCLEAR EXPLOSIONS/NEUTRON FLUENCE
The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report, 4:39522 (AD-A-059705)
NUCLEAR FACILITIES
See also FEED MATERIALS PLANTS
FUEL REPROCESSING PLANTS
HEAVY WATER PLANTS
ISOTOPE SEPARATION PLANTS
NUCLEAR FACILITIES/ENVIRONMENTAL EFFECTS
Nuclear facility monitoring in South Carolina, 4:39604 (PB-283837)
NUCLEAR FACILITIES/ENVIRONMENTAL IMPACTS
Tennessee Valley Region: a year 2000 profile, 4:38757 (DOE/ET-0064/1)
Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations (Includes glossary), 4:38758 (DOE/ET-0064/2)
NUCLEAR FACILITIES/GASEOUS WASTES
Concept for the monitoring of airborne radioactive effluents from nuclear plants in the Federal Republic of Germany with application to the Juelich Nuclear Research Center, 4:38768
NUCLEAR FACILITIES/RADIOACTIVE EFFLUENTS
Effluent monitoring: Its purpose and value, 4:38776
General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities, 4:38288
General principles of organization and design of monitoring programmes, 4:38774
Monitoring of radioactive airborne releases in the NRI Rez, 4:38769
Monitoring procedures for effluent releases from nuclear facilities at Trombay, 4:38770
Planning for unplanned releases, 4:38761
Problems of monitoring radioactive effluents, 4:38767
USERDA effluent data collection and reporting program, 4:39583
NUCLEAR FACILITIES/SAFEGUARDS
Applying new safeguards technology to existing nuclear facilities, 4:38289 (CONF-790430-2)
NUCLEAR FACILITIES/SEISMIC EFFECTS
Simplified design methods for nonlinear dynamic mechanical systems, 4:39958 (CONF-790608-1)
NUCLEAR FACILITIES/SITE SELECTION
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
NUCLEAR FRAGMENTS
See also FISSION FRAGMENTS
HYPERNUCLEI
Large fragment production calculations in relativistic heavy-ion reactions (Abrasion-ablation model, cross sections, fireball and firestreak models), 4:39865 (LBL-8561)
NUCLEAR FUEL CONVERSION
(Conversion of a fertile substance into a fissile substance.)
Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP, 4:38225
NUCLEAR FUELS
See also FUEL ELEMENTS
SPENT FUELS
NUCLEAR FUELS/CALORIMETRY
Calorimetric assay of HTGR fuel samples, 4:38226 (ORNL/TM-6665)
NUCLEAR FUELS/DATA COMPILATION
Nuclear fuel industry data, 4:38203 (PB-285941)
NUCLEAR FUELS/FABRICATION
Selected advances in materials research, 4:39106 (CONF-790343-1)
NUCLEAR FUELS/RESEARCH PROGRAMS
Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE-2875)
NUCLEAR INDUSTRY/DATA COMPILATION
Nuclear fuel industry data, 4:38203 (PB-285941)
NUCLEAR MATERIALS MANAGEMENT
Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application, 4:38297 (WCAP-9344)
Review of the effects of spiking on dynamic materials control-type nondestructive assay instrumentation, 4:38298 (WCAP-9345)
State-of-the-art survey of residual holdup in a 200 mt/yr MOX fuel fabrication facility, 4:38296 (WCAP-9128)
NUCLEAR MATERIALS MANAGEMENT/NONDESTRUCTIVE ANALYSIS
Feasibility of a Mound-designed transportable calorimeter, 4:38292 (MLM-2603)
NUCLEAR MATTER/RESEARCH PROGRAMS
Many-particle theory of nuclear system with application to neutron-star matter and other systems. Semiannual status report, February. 1978-July 1978 (Dept. of Physics, Southern Univ., Baton Rouge, La.), 4:39930 (N-78-31019)
NUCLEAR PHYSICS/RESEARCH PROGRAMS
Applied nuclear data research and development. Progress report, October 1-December 31, 1978, 4:39879 (LA-7722-PR)
Summaries of FY 1978 research in nuclear physics, 4:39877 (DOE/ER-0020)

NUCLEAR POTENTIAL
Role of the conservative potential and dissipation in heavy-ion fusion, 4:39932 (COO-3496-70)
NUCLEAR POWER/SOCIO-ECONOMIC FACTORS
Social and economic impact of nuclear energy in Brazil. A structural analysis with a generalized input-output model, 4:38894 (INIS-mf-4521)
NUCLEAR POWER/TECHNOLOGY ASSESSMENT
Comparative analysis of high technology programs: the development and diffusion of the nuclear power reactor in six nations, 4:38896 (RAND-P-6115)
NUCLEAR POWER PLANTS/AEROSOL MONITORING
Vent-air monitoring in nuclear power plants by a nuclide-specific detection system, 4:38742
NUCLEAR POWER PLANTS/AIR CLEANING SYSTEMS
Iodine filter testing, 4:38744
NUCLEAR POWER PLANTS/BUDGETS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
NUCLEAR POWER PLANTS/CONTAINMENT BUILDINGS
Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report, 4:39724 (EPRI-NP-920)
Study of the effect of hard projectiles impacting reinforced concrete walls, 4:38793 (CEA-CONF-4035)
NUCLEAR POWER PLANTS/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
NUCLEAR POWER PLANTS/ENVIRONMENTAL IMPACTS
Effects of nuclear power plants on community growth and residential property values. Final report, September 30, 1977-November 15, 1978, 4:38759 (NUREG/CR-0454)
Environmental Impacts Program, 4:38089 (ORNL-5508)
Tennessee Valley Region: a year 2000 profile, 4:38757 (DOE/ET-0064/1)
Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations (Includes glossary), 4:38758 (DOE/ET-0064/2)
NUCLEAR POWER PLANTS/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
NUCLEAR POWER PLANTS/FEDERAL ASSISTANCE PROGRAMS
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
NUCLEAR POWER PLANTS/FINANCIAL INCENTIVES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
NUCLEAR POWER PLANTS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
NUCLEAR POWER PLANTS/GASEOUS WASTES
Experience of measuring radioactive iodine by the cumulative method in gaseous discharges from nuclear power stations, 4:38737
NUCLEAR POWER PLANTS/MEETINGS
Contributions: power plants, 1977, 4:38565 (CONF-7708110-)
NUCLEAR POWER PLANTS/PUBLIC OPINION
Nuclear energy from the point of view of the population. Analysis of attitudes and motives, 4:38810 (KFA-AKI-IB-1/77)
NUCLEAR POWER PLANTS/RADIOACTIVE EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
Control of liquid radioactive effluents from nuclear power plants in the Federal Republic of Germany, 4:38764
Control of airborne radioactive releases from nuclear power plants in the Federal Republic of Germany, 4:38775
Experience in monitoring radioactive liquid effluents from nuclear facilities in the Federal Republic of Germany, 4:38765
Monitoring, evaluation and reporting of radioactive liquid and gaseous effluent releases from the CEGB nuclear power stations, 4:38766
Monitoring of gaseous and liquid effluent releases at French nuclear power stations, 4:38772
Radioactive effluent discharges. Intercomparability of data, 4:38771
NUCLEAR POWER PLANTS/RADIOACTIVE WASTE MANAGEMENT
Need for greater regulatory oversight of commercial low-level radioactive waste, 4:38300 (PB-284841)
NUCLEAR POWER PLANTS/REACTOR ACCIDENTS
Report to Congress on abnormal occurrences, October-December 1978, 4:38811 (NUREG-0090(Vol.1)(No.4))
NUCLEAR POWER PLANTS/REACTOR CONTROL SYSTEMS
New and already approved - the power plant control system PROCONTROL K by Brown-Boveri, 4:38752 (AED-Conf-78-155-027)
Transmission and distribution of information in power plants, 4:38753 (AED-Conf-78-155-033)
NUCLEAR POWER PLANTS/REACTOR COOLING SYSTEMS
Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping, 4:38826 (UCB/EERC-79/08)
NUCLEAR POWER PLANTS/REACTOR LICENSING
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 3.9.2, 4:38702 (NTISUB/B/201-003-R5)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 4.2, 4:38703 (NTISUB/B/201-004-R3)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 6.2.6, 4:38704 (NTISUB/B/201-006-R8)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 9.4.1 4:38705 (NTISUB/B/201-009-R9)
NUCLEAR POWER PLANTS/SITE SELECTION
Power plant siting (A bibliography with abstracts). Report for 1964-September 1978, 4:38760 (NTIS/PS-78/1007)
NUCLEAR POWER PLANTS/SOCIO-ECONOMIC FACTORS
Effects of nuclear power plants on community growth and residential property values. Final report, September 30, 1977-November 15, 1978, 4:38759 (NUREG/CR-0454)
NUCLEAR POWER PLANTS/STEAM GENERATORS
Workshop proceedings: flow-induced vibrations, 4:38736 (EPRI-WS-78-125)
NUCLEAR POWER PLANTS/THERMAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
NUCLEAR REACTION ANALYSIS
(Chemical analysis based on detection and analysis of prompt nuclear reaction products, e.g., gamma rays, neutrons, or charged particles.)
NUCLEAR REACTION ANALYSIS/EQUIPMENT
Analysis of coatings and thin films using energetic ions, 4:39177 (SAND-79-2076C)
NUCLEAR REACTION ANALYSIS/PERFORMANCE
Analysis of coatings and thin films using energetic ions, 4:39177 (SAND-79-2076C)
NUCLEAR REACTION KINETICS/RESEARCH PROGRAMS
Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977-October 31, 1978 (Summaries of research activities at Brown Univ.), 4:39931 (COO-3235-85)
NUCLEAR REACTIONS
See also ARGON 40 REACTIONS
BORON 11 REACTIONS
CARBON 12 REACTIONS
DEUTERON REACTIONS
ELECTRON REACTIONS
FISSION
HEAVY ION REACTIONS
KAON REACTIONS
NEUTRON REACTIONS
OXYGEN 16 REACTIONS
PHOTONUCLEAR REACTIONS
PION REACTIONS
PROTON REACTIONS
QUASI-ELASTIC SCATTERING
TRITON REACTIONS
NUCLEAR REACTIONS/COMPTON EFFECT
Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977-October 31, 1978 (Summaries of research activities at Brown Univ.), 4:39931 (COO-3235-85)
NUCLEAR REACTORS
See REACTORS
NUCLEAR WEAPON TESTS
See NUCLEAR EXPLOSIONS
NUCLEASES/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
NUCLEI
See also HYPERNUCLEI
ISOBARIC NUCLEI
LIGHT NUCLEI
NUCLEI/ENERGY LEVELS
Nuclear excitations and reaction mechanisms. Report of progress November 1, 1977-October 31, 1978 (Summaries of research activities at Brown Univ.), 4:39931 (COO-3235-85)
NUCLEON-NUCLEON INTERACTIONS
See also PROTON-PROTON INTERACTIONS

NUCLEON-NUCLEON INTERACTIONS/EFFECTIVE RANGE THEORY
Converged values of second-order core-polarization diagrams with orthogonalized-plane-wave intermediate states, 4:39936
NUCLEONS
See also NEUTRONS
PROTONS
NUCLEONS/GLUON MODEL
Results on nucleon structure functions in quantum chromodynamics, 4:39873
NUCLEONS/STRUCTURE FUNCTIONS
Results on nucleon structure functions in quantum chromodynamics, 4:39873
NUCLEOSIDES/CRYSTAL STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3′-5′) guanosine and acridine orange: 5-iodocytidylyl(3′-5′) guanosine, 4:39245 (UR-3490-1574)
Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3′-5′)guanosine, 4:39244 (UR-3490-1573)
NUCLEOSIDES/MOLECULAR STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3′-5′) guanosine and acridine orange: 5-iodocytidylyl(3′-5′) guanosine, 4:39245 (UR-3490-1574)
Visualization of drug-nucleic acid interactions at atomic resolution. IV. Structure of an aminoacridine/dinucleoside monophosphate crystalline complex, 9-aminoacridine: 5-iodocytidylyl(3′-5′)guanosine, 4:39244 (UR-3490-1573)
NUCLEOTIDES
See also ATP
NUCLEOSIDES
NUCLEOTIDES/EXCITED STATES
Time dependence of triplet-singlet excitation transfer from compact poly rA to bound dye at 77 k, 4:39243
NUMAK REACTORS/FAST MAGNETOACOUSTIC WAVES
Fast magnetosonic wave heating of the NUWMAK tokamak reactor, 4:39966 (UWFDM-227)
NUMAK REACTORS/HIGH-FREQUENCY HEATING
Fast magnetosonic wave heating of the NUWMAK tokamak reactor, 4:39966 (UWFDM-227)
NUTS
See FASTENERS
NYMPHS
See LARVAE

O

OAPEC/ECONOMIC POLICY
Understanding of the importance of Arab/Islamic funds available for development projects and economic support, 4:38871
OAPEC/ENERGY POLICY
Concluding statement of the First Arab Energy Conference, Abu Dhabi, United Arab Emirates. March 4-8, 1979, 4:38922
Energy situation in the Arab world, 4:38923
OCCUPANTS/INJURIES
An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974-30 June 1977, 4:38938 (PB-284018)
OCEAN THERMAL ENERGY CONVERSION/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
OCEAN THERMAL ENERGY CONVERSION/ECONOMICS
Economic and technical feasibility analysis of ocean thermal energy conversion. Final report, 4:38413 (PB-285781)
OCEAN THERMAL ENERGY CONVERSION/FEASIBILITY STUDIES
Economic and technical feasibility analysis of ocean thermal energy conversion. Final report, 4:38413 (PB-285781)
OCEAN THERMAL ENERGY CONVERSION/HEAT EXCHANGERS
Qualification of stainless steel for OTEC heat exchanger tubes, 4:38410 (ANL/OTEC-001)
OCEAN THERMAL POWER PLANTS/HEAT EXCHANGERS
Compact heat exchangers for sea thermal power plants. Final technical progress report, May 1, 1977-March 31, 1978, 4:38412 (COO-4300-7)
OCEAN THERMAL POWER PLANTS/MATHEMATICAL MODELS
Comparative study of working fluids for OTEC power plants, 4:38411 (ANL/OTEC-TM-1)
OCEAN THERMAL POWER PLANTS/WORKING FLUIDS
Comparative study of working fluids for OTEC power plants, 4:38411 (ANL/OTEC-TM-1)
OCEANOGRAPHY/RESEARCH PROGRAMS
Marine-related research at MIT, 1978: including projects on marine-resources, ocean utilization and coastal zone management, 4:39728 (PB-286346)
ODOCOILEUS
See DEER
OFF-PEAK ENERGY STORAGE/SODIUM-SULFUR BATTERIES
Electrochemical storage cell (Patent), 4:38851
OFF-PEAK POWER
Electrical load management: the British experience. Part II (Nighttime demand at record highs), 4:38937
OFFSHORE DRILLING/ECONOMIC IMPACT
Planning for offshore oil development. Economic forecasts: lower Cook Inlet lease sale, 4:38159 (PB-285491)
OFFSHORE DRILLING/ENVIRONMENTAL EFFECTS
The West Indian manatee (Trichechus manatus) in Florida: a summary and analysis of biological, ecological, and administrative problems affecting preservation and restoration of the population. Final report, 4:39609 (PB-285410)
OFFSHORE DRILLING/OIL SPILLS
Oil spills: the policy of prevention and the strategy of recovery, 4:38171 (PB-285931)
OHIO/GEOTHERMAL EXPLORATION
Geothermal exploration methods and results: inland states, 4:38519 (LA-UR-79-665)
OHMIC RESISTANCE
See ELECTRIC CONDUCTIVITY
OIL BURNERS/DESIGN
Energy-efficient oil burner (Patent), 4:39347
OIL FIELDS/ENVIRONMENTAL EFFECTS
Environmental assessment of an active oil field in the northwestern Gulf of Mexico, 1976-1977. Annual report, 4:38165 (PB-283890)
OIL FIELDS/EXPLOITATION
Offshore oil development in lower Cook Inlet. Implications for the Kenai Peninsula, 4:38143 (PB-284019)
OIL FIELDS/SOCIAL IMPACT
Offshore oil development in lower Cook Inlet. Implications for the Kenai Peninsula, 4:38143 (PB-284019)
OIL SANDS/HOT-WATER PROCESSES
Pumping hot water to increase oil yield from fissured-porous seams with highly viscous oil, 4:38196
OIL SANDS/PROCESSING
Substantiation of the technological principles for working bituminous fields of Tataria, 4:38198
OIL SHALE INDUSTRY
See also MINERAL INDUSTRY
OIL SHALE INDUSTRY/CHEMICAL EFFLUENTS
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
OIL SHALE MINING
See also SURFACE MINING
UNDERGROUND MINING
OIL SHALE MINING/LAND RECLAMATION
Rehabilitation potential and practices of Colorado oil shale lands. Progress report, June 1, 1978-May 31, 1979, 4:38200 (COO-4018-3)
OIL SHALE PROCESSING PLANTS/WATER POLLUTION
Assessment and control of water contamination associated with shale oil extraction and processing. Work plan, 4:38202 (LA-7697)
OIL SHALES
See also BLACK SHALES
OIL SHALES/DIELECTRIC PROPERTIES
Method for in situ heat processing of hydrocarbonaceous formations (Patent), 4:38195
OIL SHALES/EXPLOSIVE FRACTURING
Calculation of explosive rock breakage: oil shale, 4:38188 (LA-UR-79-646)
Techniques and problems relating to in situ measurment of stress waves in rubblization experiments, 4:38189 (SAND-78-2268C)
OIL SHALES/HYDRAULIC TRANSPORT
The hydraulic transportation of oil shale. Research report, 4:38186 (PB-283817)
OIL SHALES/IN-SITU PROCESSING
Method for in situ heat processing of hydrocarbonaceous formations (Patent), 4:38195

OIL SHALES/IN-SITU RETORTING
BX in situ oil shale project. Quarterly technical progress report, March 1-May 31, 1977, 4:38190 (FE-1747-1)
Dispersion of catalysts with explosives for in situ mining of carbonaceous minerals (Patent), 4:38070
Oil shale in situ research and development. Quarterly report No. 1, August 1-October 31, 1977, 4:38193 (TID-28955)
Oil shale in situ research and development. Quarterly report No. 3, February 1-April 30, 1978, 4:38194 (TID-28958)
Use of electrical geophysical techniques to map and monitor in situ oil shale recovery processes, 4:38192 (SAND-79-0746C)
OIL SHALES/RESERVES
Energy analysis and oil shale reserves, 4:38187 (N-78-31584)
OIL SHALES/RETORTING
The relative costs of producing syncrude from oil shales of various grades under varying conditions, 4:38197 (N-78-31268)
OIL SHALES/ROCK MECHANICS
Calculation of explosive rock breakage: oil shale, 4:38188 (LA-UR-79-646)
OIL SPILLS/BIOLOGICAL EFFECTS
Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB-285646)
Response of a salt marsh to oil spill and cleanup: biotic and erosional effects in the Hackensack Meadowlands, New Jersey. Final report, May 1976-December 1977, 4:38167 (PB-285211)
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
OIL SPILLS/BIOLOGICAL INDICATORS
Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey, 4:39614 (IVL-B-445)
OIL SPILLS/CHEMICAL COMPOSITION
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
OIL SPILLS/CLEANING
Oil spills: the policy of prevention and the strategy of recovery, 4:38171 (PB-285931)
OIL SPILLS/DIFFUSION
A study to conduct experiments concerning turbulent dispersion of oil slicks. Final report, October 1976-April 1978, 4:38162 (AD-A-058802)
OIL SPILLS/EMULSIFICATION
Techniques for mixing dispersants with spilled oil. Final report 1976, 4:38170 (PB-285679)
OIL SPILLS/ENVIRONMENTAL EFFECTS
Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB-285646)
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
OIL SPILLS/ENVIRONMENTAL IMPACTS
Response of a salt marsh to oil spill and cleanup: biotic and erosional effects in the Hackensack Meadowlands, New Jersey. Final report, May 1976-December 1977, 4:38167 (PB-285211)
OIL SPILLS/ENVIRONMENTAL TRANSPORT
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
OIL SPILLS/REGULATIONS
Oil spills: the policy of prevention and the strategy of recovery, 4:38171 (PB-285931)
OIL SPILLS/RISK ASSESSMENT
Crisis science: investigations in response to the Argo Merchant oil spill. Sea grant report, 4:39617 (PB-285646)
OIL WELLS
See also PETROLEUM
OIL WELLS/CARBON DIOXIDE INJECTION
Oil recovery by carbon dioxide injection. Annual report, July 1977-July 1978, 4:38142 (ORO-5301-34)
OIL WELLS/ELECTRICAL SURVEYS
Frequency distortions in a multistrand cable during electrical surveying of wells, 4:38136
OIL WELLS/FOULING
Effect of active water-soluble organic compounds of petroleum on salt deposits in petroleum equipment, 4:38157
OIL WELLS/IN-SITU COMBUSTION
Bodcau In Situ Combustion Project. Second annual report, July 1, 1977-June 30, 1978, 4:38144 (SAN-1189-3)
OIL WELLS/MICROEMULSION FLOODING
Assessment of potential increased oil production by polymer-waterflood in northern and southern mid-continent oil fields. Progress report for the quarter ending December 31, 1978, 4:38141 (DOE/ET-00026-8)
OIL WELLS/MISCIBLE-PHASE DISPLACEMENT
Study of hydrophobic acid emulsions, 4:38148
OIL WELLS/STEAM INJECTION
DEEP STEAM Project 16 enhanced oil recovery. Quarterly report, October 1-December 31, 1978, 4:38145 (SAND-79-0562)
OIL WELLS/WATERFLOODING
Pumping an aqueous solution of polyacrylamide, 4:38156
Pumping hot water to increase oil yield from fissured-porous seams with highly viscous oil, 4:38196
Use of water-soluble petroleum sulfo acids for stimulating well operations, 4:38147
OLEFINS
See ALKENES
OLIGONUCLEOTIDES
See NUCLEOTIDES
ON-LINE CONTROL SYSTEMS/ELECTRONIC CIRCUITS
Stepping motor translator (Patent application), 4:39344
ONTARIO PHWR PICKERING-1 REACTOR
See PICKERING-1 REACTOR
OOCYTES/RADIONUCLIDE KINETICS
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{3}H (Mice), 4:39692 (BNL-25910)
OOGENESIS/GENETIC RADIATION EFFECTS
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{3}H (Mice), 4:39692 (BNL-25910)
OPEN-CYCLE MHD GENERATORS/ELECTRODES
Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009-)
OPERATORS(QUANTUM MECHANICAL)
See QUANTUM OPERATORS
OPTICAL MICROSCOPES/IMAGE PROCESSING
Quantitative surface topography determination by Nomarski reflection microscopy I. Theory, 4:39514
OPTIMIZATION/ALGORITHMS
Simulation test approach to the evaluation of nonlinear optimization algorithms, 4:40046
ORBITAL SOLAR POWER PLANTS/CONSTRUCTION
Satellite solar power station construction in space, 4:38405
ORBITAL SOLAR POWER PLANTS/MICROWAVE POWER TRANSMISSION
Design, fabrication and testing of a CFA for use in the solar power satellite. Final report, 4:38404 (N-78-31143)
Ionosphere/microwave beam interaction study. Final report, 4:38403 (N-78-30475)
ORBITAL SOLAR POWER PLANTS/SOLAR CELL ARRAYS
Evaluation of solar cells and arrays for potential solar power satellite applications. Final report, 4:38402 (N-78-27538)
ORGANIC CHLORINE COMPOUNDS
See also CHLORINATED ALIPHATIC HYDROCARBONS
ORGANIC CHLORINE COMPOUNDS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
ORGANIC CHLORINE COMPOUNDS/SEPARATION PROCESSES
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
ORGANIC COMPOUNDS
See also AMINES
HYDROCARBONS
NUCLEOTIDES
ORGANIC NITROGEN COMPOUNDS
ORGANIC SULFUR COMPOUNDS
PROTEINS
ORGANIC COMPOUNDS/ECOLOGICAL CONCENTRATION
Tropospheric aerosols, 4:39535
ORGANIC COMPOUNDS/REMOVAL
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM-6672)
ORGANIC NITROGEN COMPOUNDS
See also ACRIDINE ORANGE
ACRIDINES
AMINES
HEMOGLOBIN
NITRILES
NUCLEOTIDES
PROFLAVINE
PROTEINS
TRYPTOPHAN
URACILS
ORGANIC NITROGEN COMPOUNDS/BIOLOGICAL ACCUMULATION
Synthetic Fuels Program, 4:38090 (ORNL-5508)
ORGANIC NITROGEN COMPOUNDS/BIOLOGICAL EFFECTS
Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N'-nitro-N-nitrosoguanidine, 4:39642
ORGANIC NITROGEN COMPOUNDS/CLASSIFICATION
Clean solid and liquid fuels from coal. Quarterly progress report, April-June 1978, 4:38074 (FE-2047-9)

ORGANIC NITROGEN COMPOUNDS/TOXICITY
Synthetic Fuels Program, 4:38090 (ORNL-5508)
ORGANIC SOLVENTS/HYDROGENATION
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)
ORGANIC SULFUR COMPOUNDS
See also DISULFIDES
HEPARIN
THIOLS
ORGANIC SULFUR COMPOUNDS/GAS CHROMATOGRAPHY
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
ORGANIC SULFUR COMPOUNDS/REMOVAL
Coal desulfurization using microwave energy. Final report, August 1976-October 1977, 4:38045 (PB-285880)
ORNL ISOCHRONOUS CYCLOTRON/ION BEAM INJECTION
Buncher development for ORIC injection, 4:39425 (LA-7445-C)
ORNL ISOCHRONOUS CYCLOTRON/MAGNETIC FIELDS
Implementation of the ORIC magnetic field measurements, 4:39442 (CONF-790327-8)
OSMIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
OSMIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
OSMIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
OSTEOSARCOMAS/RADIOINDUCTION
Geometry of flattened cells on endosteal surfaces of human bone: implications for the induction of osteosarcoma and the shape of the dose-response relationship (^{226}Ra, ^{239}Pu), 4:39675 (ANL-78-65(Pt.2))
OTTO HAHN REACTOR/PRIMARY COOLANT CIRCUITS
Gases and corrosion products in the primary circuit of the NS 'Otto Hahn', 4:38786 (GKSS-77/E/35)
NS Otto Hahn: operational chemistry of the primary and secondary circuits, 4:38787
OTTO HAHN REACTOR/SECONDARY COOLANT CIRCUITS
NS Otto Hahn: operational chemistry of the primary and secondary circuits, 4:38787
OTTO HAHN REACTOR/WATER CHEMISTRY
NS Otto Hahn: operational chemistry of the primary and secondary circuits, 4:38787
OXALALDEHYDE
See GLYOXAL
OXIDATION
See also COMBUSTION
OXIDATION/AUGER ELECTRON SPECTROSCOPY
AES study of oxidation of surface and bulk sulfides of Ni, 4:39150
OXIDATION/MEASURING INSTRUMENTS
Oxide thickness monitor, 4:39506 (N-78-28429)
OXIRANS
See EPOXIDES
OXYGEN/ADSORPTION
Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977-November 30, 1978, 4:39551 (ORO-5592-2)
Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, May 1-July 31, 1978, 4:38056 (FE-2229-10)
OXYGEN/CHARGED-PARTICLE TRANSPORT
Proton beam excited lasers, 4:39286 (CONF-771035-P2)
OXYGEN/CHEMICAL REACTION KINETICS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
OXYGEN/CHEMICAL REACTIONS
Experimental measurement of the rate of the reaction O(3p) + H2(v = 0) yields OH(v = 0) + H at T = 296°K. Interim report, 4:39218 (AD-A-059447)
OXYGEN/CHEMISORPTION
ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions, 4:39224 (LBL-8975)
Oxygen chemisorption on Bi (0001): LEED/Auger/loss study, 4:39154
OXYGEN/DESORPTION
Analysis of chemistry at ionically bonded surfaces by electron stimulated desorption(a), 4:39225 (LBL-8975)
OXYGEN/PRESSURE DEPENDENCE
AES study of oxidation of surface and bulk sulfides of Ni, 4:39150
OXYGEN 16/ENERGY LEVELS
Origin of gross structure in $^{12}C + ^{12}C$ and $^{16}O + ^{16}O$ inelastic scattering, 4:39886
OXYGEN 16 REACTIONS/COMPOUND-NUCLEUS REACTIONS
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912
OXYGEN 16 REACTIONS/DEEP INELASTIC SCATTERING
Energy dependence of peripheral reactions induced by heavy ions (Differential cross sections, 140 and 315 MeV, yields), 4:39915
OXYGEN 16 REACTIONS/FISSION
Incomplete momentum transfer in peripheral heavy-ion collisions at 20 MeV/nucleon, 4:39925
OXYGEN 16 REACTIONS/FUSION REACTIONS
Effect of nuclear deformation on heavy-ion fusion (Cross sections, excitation, lifetime potential), 4:39911 (INIS-mf-4427)
OXYGEN 16 REACTIONS/INELASTIC SCATTERING
Origin of gross structure in $^{12}C + ^{12}C$ and $^{16}O + ^{16}O$ inelastic scattering, 4:39886
OXYGEN 16 TARGET/OXYGEN 16 REACTIONS
Origin of gross structure in $^{12}C + ^{12}C$ and $^{16}O + ^{16}O$ inelastic scattering, 4:39886
OXYGEN 16 TARGET/PHOTONUCLEAR REACTIONS
Isobars and the medium-energy (γ,p) reaction, 4:39888
OXYGEN 16 TARGET/PION PLUS REACTIONS
Low energy π^+ scattering from light nuclei, 4:39896
OXYGEN 16 TARGET/PROTON REACTIONS
Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50-90 MeV, 4:39895
OXYGEN EFFECT (RADIOBIOLOGY)
See OXYGEN
OZONE/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
OZONE/CHEMICAL REACTION KINETICS
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
OZONE/COORDINATED RESEARCH PROGRAMS
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)
OZONE/ENVIRONMENTAL EFFECTS
Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977-15 April 1978, 4:39547 (N-78-27687)
OZONE/ENVIRONMENTAL TRANSPORT
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
OZONE/MONITORING
An evaluation of in situ ozone sensor performance during a cold frontal passage, 4:39532 (N-78-27706)
OZONE/USES
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM-6672)

P

PACIFIC NORTHWEST REGION
See also ALASKA
IDAHO
WASHINGTON
PACIFIC NORTHWEST REGION/HYDROELECTRIC POWER
Some hydrologic analysis techniques, 4:38329
PACIFIC OCEAN/PLANKTON
Horizontal undependability in the planktonic environment, 4:39610
PACKAGING/REGULATORY GUIDES
Standard format and content of Part 71 applications for approval of packaging of Type B, large quantity, and fissile radioactive material, 4:39278 (REG/G-7.9)
PAIRING INTERACTIONS/RESIDUAL INTERACTIONS
Coherent residual interactions: pairing plus particle-hole (Quasi-particles, schematic Hamiltonian), 4:39929
PALLADIUM/CATALYTIC EFFECTS
Catalytic hydrogenation process, 4:39246
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)

PALLADIUM/CRYSTAL FIELD
Self-consistent mixed-basis approach to the electronic structure of solids, 4:39159
PALLADIUM/ELECTRONIC STRUCTURE
Self-consistent mixed-basis approach to the electronic structure of solids, 4:39159
PALLADIUM/SORPTIVE PROPERTIES
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
PALLADIUM/SPUTTERING
Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
PALLADIUM 109/ENERGY LEVELS
Unique parity states in ^{109}Pd from the (n,γ) reaction: calculations for rotation aligned and odd mass IBA models (Low spin, antialigned levels, coupling, rotor core), 4:39908 (BNL-25877)
PALLADIUM COMPLEXES/ELECTRIC CONDUCTIVITY
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)
PALLADIUM COMPLEXES/SYNTHESIS
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)
PAPER/DRYING
Apparatus for hot gas heat transfer particularly for paper drying (Patent), 4:39042
PAPER INDUSTRY/CHEMICAL EFFLUENTS
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
PARABOLIC TROUGH COLLECTORS/HEAT LOSSES
Heat loss reduction techniques for annular solar receiver designs, 4:38499 (SAND-78-1769)
PARABOLIC TROUGH COLLECTORS/PERFORMANCE TESTING
Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND-78-0982)
Performance testing of the del concentrating solar collector, 4:38501 (SAND-79-0515)
PARABOLIC TROUGH COLLECTORS/TEST FACILITIES
Design considerations for a proposed passive vacuum solar annular receiver, 4:38498 (SAND-78-0982)
PARAFFINS
See ALKANES
PARAHO PROCESS/ENVIRONMENTAL EFFECTS
Environmental sampling of the Paraho Oil Shale Retort Process at Anvil Points, 4:38201 (EPA-625/9-77-002)
PARAHO PROCESS/PROCESS SOLUTIONS
Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976-July 1977, 4:38199 (PB-284027)
PARTHENOGENESIS
See REPRODUCTION
PARTICLE BEAMS/BEAM DYNAMICS
Method of transfer maps for linear and nonlinear beam elements, 4:39402 (LA-UR-79-699)
PARTICLE SIZE CLASSIFIERS/PERFORMANCE TESTING
Dynamic particle size measurement of coal dust. Final report, 1 October 1973-30 November 1976, 4:38102 (PB-285096)
PARTICLES/FRAGMENTATION
Laser-particulate control for open-cycle, coal fired gas turbines, 4:38601 (BNL-25587)
PARTICLES/INVENTORIES
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)
PARTICLES/MONITORING
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
PARTICLES/REMOVAL
Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, May 1-July 31, 1978, 4:38046 (ACD-38391-12)
PARTICLES (FUEL)
See FUEL PARTICLES
PARTON MODEL/FRAGMENTATION
Hadronic fragmentation initiated by pointlike probes, 4:39849
PARTON MODEL/RECOMBINATION
Parton recombination model, 4:39852 (DOE/ER/70004-207)
PASSIVE SOLAR COOLING SYSTEMS
Sunearth home, 4:38435 (CONF-780337-P2)
PASSIVE SOLAR COOLING SYSTEMS/ARCHITECTURE
Solar atrium: a hybrid solar heating and cooling system, 4:38423 (CONF-780337-P1)
PASSIVE SOLAR COOLING SYSTEMS/PERFORMANCE
Energy efficient office building for the state of California, 4:38426 (CONF-780337-P1)
Passive solar house based on balanced direct gain heating and night ventilation cooling, 4:38424 (CONF-780337-P1)
PASSIVE SOLAR COOLING SYSTEMS/REVIEWS
Passive systems for solar heating and cooling: historical perspective, 4:38418 (CONF-780337-P1)
PASSIVE SOLAR COOLING SYSTEMS/SOLAR PONDS
Office building for an era of transitions: application of the skytherm system of passive heating and cooling to a moderate density office building, 4:38427 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS
Comprehensive approach to window design for energy conservation, 4:38458 (CONF-780337-P3)
Direct gain passive design: delap residence (Delap residence), 4:38433 (CONF-780337-P2)
Gayland B. Witherspoon residence, Central, S.C., 4:38443 (CONF-780337-P2)
Harrison residence: Placitas, New Mexico, 4:38441 (CONF-780337-P2)
House at Crooked Creek. Direct gain passive solar design in an extreme climate, 4:38444 (CONF-780337-P2)
Hybrid solar system in Los Alamos, New Mexico, 4:38439 (CONF-780337-P2)
Lindeberg residence: a DOE funded hybrid solar house, 4:38438 (CONF-780337-P2)
Lumsdaine solar house, 4:38440 (CONF-780337-P2)
Soldyne house, 4:38434 (CONF-780337-P2)
Sunearth home, 4:38435 (CONF-780337-P2)
PASSIVE SOLAR HEATING SYSTEMS/ARCHITECTURE
Daylighting design for the Sacramento State Office Building Competition, 4:38428 (CONF-780337-P1)
Solar atrium: a hybrid solar heating and cooling system, 4:38423 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/BIBLIOGRAPHIES
Passive solar design: a short bibliography for practitioners, 4:38468 (HCP/M4113-01)
Passive solar design: a survey of monitored buildings, 4:38466 (HCP/CS-4113-2)
Passive solar design. An extensive bibliography, 4:38467 (HCP/CS-4113-3)
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
PASSIVE SOLAR HEATING SYSTEMS/CALCULATION METHODS
Prediction of performance of a minimal storage passive solar house: the Crosley home, 4:38452 (CONF-780337-P3)
PASSIVE SOLAR HEATING SYSTEMS/COMMERCIALIZATION
Passive solar energy focus group results, 4:38365 (DOE/TIC-10016)
PASSIVE SOLAR HEATING SYSTEMS/COMPARATIVE EVALUATIONS
Knowing and loving, and never knowing: two houses, 4:38442 (CONF-780337-P2)
PASSIVE SOLAR HEATING SYSTEMS/COMPUTER CALCULATIONS
Quantitative method for the design of buildings with comfortable microclimates by passive control of solar effects, 4:38453 (CONF-780337-P3)
PASSIVE SOLAR HEATING SYSTEMS/DESIGN
Design tool to assess room air temperatures of a passively heated space, 4:38455 (CONF-780337-P3)
Earth-integrated direct gain residence using concrete cored slab, 4:38469 (IS-M-192)
Model design process for passive solar architecture, 4:38422 (CONF-780337-P1)
Model design process for passive solar architecture, 4:38431 (CONF-780337-P2)
South-wall heating system for a commercial building employing tilt-up concrete construction, 4:38456 (CONF-780337-P3)
Third overlay, 4:38425 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/ECONOMIC ANALYSIS
Preliminary economic evaluation of generic passive solar energy system/building applications, 4:38359 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/FINANCIAL INCENTIVES
California's passive program, 4:38364 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/GOVERNMENT POLICIES
Passive solar energy focus group results, 4:38365 (DOE/TIC-10016)
PASSIVE SOLAR HEATING SYSTEMS/HYBRID SYSTEMS
Hull residence: a passive solar hybrid system, 4:38432 (CONF-780337-P2)
PASSIVE SOLAR HEATING SYSTEMS/LEGISLATION
California's passive program, 4:38364 (CONF-780337-P1)

PASSIVE SOLAR HEATING SYSTEMS/MATHEMATICAL MODELS
Some analytic models of passive solar building performance: a theoretical approach to the design of energy-conserving buildings, 4:38470 (LBL-7811)
PASSIVE SOLAR HEATING SYSTEMS/MEETINGS
Passive solar energy planning aid kit for building design architects and planners, 4:38417 (CONF-780337-P1)
Passive solar energy planning aid kit for the business community and general public, 4:38429 (CONF-780337-P2)
Passive solar energy planning aid kit for solar energy systems engineers, 4:38451 (CONF-780337-P3)
PASSIVE SOLAR HEATING SYSTEMS/PAYBACK PERIOD
Beyond passive design: toward an integrative conservation technology, 4:38421 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/PERFORMANCE
Energy efficient office building for the state of California, 4:38426 (CONF-780337-P1)
Kelbaugh House: recent performance, 4:38450 (CONF-780337-P2)
Passive heated residences, 4:38436 (CONF-780337-P2)
Passive solar house based on balanced direct gain heating and night ventilation cooling, 4:38424 (CONF-780337-P1)
Passive solar heated house and greenhouse on Cape Cod, description and performance, 4:38447 (CONF-780337-P2)
Prediction of performance of a minimal storage passive solar house: the Crosley home, 4:38452 (CONF-780337-P3)
Simple direct gain passive house performance prediction model, 4:38454 (CONF-780337-P3)
Solar consumer: living in a glass house, 4:38430 (CONF-780337-P2)
Trombe wall with phase change storage material, 4:38457 (CONF-780337-P3)
Weather responsive building skins: concepts and configurations, 4:38459 (CONF-780337-P3)
PASSIVE SOLAR HEATING SYSTEMS/PERFORMANCE TESTING
Testing and simulation of passive solar systems, 4:38460 (CONF-780337-P3)
PASSIVE SOLAR HEATING SYSTEMS/PLANNING
Barriers, advantages, and incentives for passive solar design, 4:38420 (CONF-780337-P1)
Natural solar/microclimate/solid-state design, 4:38419 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/REGULATIONS
Report of the solar passive subcommittee for the Minnesota Energy Agency: review and update, 4:38363 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/REVIEWS
Beyond passive design: toward an integrative conservation technology, 4:38421 (CONF-780337-P1)
Passive systems for solar heating and cooling: historical perspective, 4:38418 (CONF-780337-P1)
PASSIVE SOLAR HEATING SYSTEMS/SOLAR PONDS
Office building for an era of transitions: application of the skytherm system of passive heating and cooling to a moderate density office building, 4:38427 (CONF-780337-P1)
PATIENTS/BIOLOGICAL RADIATION EFFECTS
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
PATIENTS/RADIATION DOSES
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB-285628)
Reduction of patient dose delivered by CHR diagnostic x-ray examinations, 4:39661 (ANL-78-65(Pt.2))
PATIENTS/RADIATION PROTECTION
Annotated bibliography on the selection of patients for x-ray examination. Final report, July 1978, 4:39664 (PB-285628)
PCM ACCIDENTS
See POWER-COOLING-MISMATCH ACCIDENTS
PDP COMPUTERS/CONTROL EQUIPMENT
Computer automation of an electron-beam welder, 4:39097 (Y/DA-8239)
PEAKING POWER PLANTS/GAS TURBINES
Comparison of projected electric-utility peaking-gas-turbine energy requirements to potential alcohol fuels availability: 1980-2000, 4:38591 (HCP/M2098-02)
PEBBLE BED REACTORS/REACTOR CORES
Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores, 4:38641 (LA-7709-T)
PEC BRASIMONE REACTOR/BOILING DETECTION
Results of acoustic and temperature noise measurements on sodium cooled electrically heated 7 rod bundle, 4:38691
PENTANE/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
PEP STORAGE RINGS
(Positron-electron-proton storage ring.)
PEP STORAGE RINGS/BEAM DYNAMICS
Longitudinal feedback system for PEP, 4:39484 (SLAC-PUB-2267)
Proposed orbit and vertical dispersion correction system for PEP, 4:39483 (SLAC-PUB-2265)
PEP STORAGE RINGS/FEEDBACK
Longitudinal feedback system for PEP, 4:39484 (SLAC-PUB-2267)
PEP STORAGE RINGS/ORBIT STABILITY
Proposed orbit and vertical dispersion correction system for PEP, 4:39483 (SLAC-PUB-2265)
PEP STORAGE RINGS/POLARIZED BEAMS
Experimental review of beam polarization in high energy e^+e^- storage rings, 4:39481 (SLAC-PUB-2258)
PEP STORAGE RINGS/RF SYSTEMS
PEP II RF system, 4:39479 (LBL-8887)
PERSONNEL
See also DIAL PAINTERS
MILITARY PERSONNEL
MINERS
PERSONNEL/RADIATION DOSES
Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se-selenomethionine, 4:39689 (ANL-78-65(Pt.2))
PERSONNEL/RADIATION PROTECTION
Public meeting on radiation safety for industrial radiographerss: remarks, questions and answers at five NRC regional meetings, 4:39663 (NUREG-0495)
PERSONNEL/SCINTISCANNING
Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se-selenomethionine, 4:39689 (ANL-78-65(Pt.2))
PETRA STORAGE RING/POLARIZED BEAMS
Experimental review of beam polarization in high energy e^+e^- storage rings, 4:39481 (SLAC-PUB-2258)
PETROCHEMICAL PLANTS/WASTE PROCESSING
Thermal regeneration of activated carbon, 4:38166 (PB-284065)
PETROCHEMICALS/ABSORPTION
Thermal regeneration of activated carbon, 4:38166 (PB-284065)
PETROCHEMICALS/ENVIRONMENTAL EFFECTS
Thermal regeneration of activated carbon, 4:38166 (PB-284065)
PETROLEUM
See also OIL WELLS
SHALE OIL
PETROLEUM/ALLOCATIONS
Allocation of petroleum feedstock: Northern Illinois Gas Company, Aux Sable SNG Plant, Grundy County, IL, 4:39635 (DOE/EA-0063)
PETROLEUM/COST
Oil and gas replacement cost: development and production. Volume 1. Discussion of methodology, exhibits, and projections. Final report, 4:38158 (DOE/TIC-10078)
PETROLEUM/ENHANCED RECOVERY
Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977-September 1978, 4:38138 (BETC-0001-1)
PETROLEUM/ENVIRONMENTAL IMPACTS
Environmental Impacts Program, 4:38089 (ORNL-5508)
PETROLEUM/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
PETROLEUM/MARITIME TRANSPORT
Offshore vessel traffic management (OVTM) study. volume i. executive summary. Final report Aug 77-Jun 78, 4:38172 (AD-A-059655)
PETROLEUM/PNEUMATIC TRANSPORT
Operational features of boreholes equipped with heat-insulated throwout lines with accessory thermal minerals, 4:38173
PETROLEUM/TRADE
Effects of Alaskan North Slope crude oil and continued crude oil production at Elk Hills Naval Petroleum Reserve, 4:38160 (PB-285801)
PETROLEUM DEPOSITS
See also OIL FIELDS
PETROLEUM DEPOSITS/EXPLOITATION
Managing oil and gas activities in coastal environments, 4:38163 (PB-283677)
PETROLEUM DEPOSITS/EXPLORATION
Exploration of oil and gas in the Federal Republic of Germany in 1977, 4:38134
PETROLEUM DEPOSITS/GEOLOGICAL SURVEYS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135
PETROLEUM DEPOSITS/GEOPHYSICAL SURVEYS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135

PETROLEUM DEPOSITS/OIL YIELDS
Evaluation of final petroleum yield of Ural-Povolzh'e deposits in the early stages of their study, 4:38155
PETROLEUM DEPOSITS/PLUGGING
Precipitation of hydrolyzed polyacrylonitride in a porous media as applied to the isolation of injected water, 4:38146
PETROLEUM DEPOSITS/RESERVOIR ROCK
Analysis of five-spot tracer tests to determine reservoir layering, 4:38133 (SAN-1265-8)
PETROLEUM DEPOSITS/SATURATION
Bell Creek residual oil saturation technology test. Project quarterly report for period October 1978-December 1978, 4:38140 (BETC-2180-4)
PETROLEUM INDUSTRY
See also MINERAL INDUSTRY
PETROLEUM INDUSTRY/ECONOMIC IMPACT
Alaska OCS socioeconomic studies program. Technical report number 17. Monitoring petroleum activities in the Gulf of Alaska and lower Cook Inlet between April 1975 and June 1978. Final report, 4:38168 (PB-285408)
Alaska OCS socioeconomic studies program. Technical report number 18. Beaufort Sea petroleum development scenarios: economic and demographic impacts. Technical report, 4:38169 (PB-285409)
PETROLEUM INDUSTRY/ENVIRONMENTAL IMPACTS
Allocation of petroleum feedstock: Northern Illinois Gas Company, Aux Sable SNG Plant, Grundy County, IL, 4:39635 (DOE/EA-0063)
PETROLEUM INDUSTRY/HORIZONTAL DIVESTITURE
Horizontal divestiture of energy companies, 4:38925
PETROLEUM INDUSTRY/SOCIAL IMPACT
Alaska OCS socioeconomic studies program. Technical report number 17. Monitoring petroleum activities in the Gulf of Alaska and lower Cook Inlet between April 1975 and June 1978. Final report, 4:38168 (PB-285408)
PETROLEUM PRODUCTS
See also GASOLINE
LUBRICATING OILS
PETROLEUM PRODUCTS/AIR POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
PETROLEUM PRODUCTS/CONSUMPTION RATES
Crude oil and products markets in industrial countries. VII. Japan, 4:38928
PETROLEUM PRODUCTS/LAND POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
PETROLEUM PRODUCTS/WATER POLLUTION
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
PETROLEUM REFINERIES/ENERGY CONSUMPTION
Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States, 4:39040 (HCP/M5056-02)
PETROLEUM REFINERIES/WASTE HEAT UTILIZATION
Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States, 4:39040 (HCP/M5056-02)
PETROLEUM REFINERIES/WASTE PROCESSING
Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater (Granular vs. powdered), 4:38161 (ANL/WR-79-3)
PETROLEUM SULFONATES
Use of water-soluble petroleum sulfo acids for stimulating well operations, 4:38147
PETROLEUM SULFONATES/SYNTHESIS
Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977-September 1978, 4:38138 (BETC-0001-1)
PFR REACTOR/BOILING DETECTION
Acoustic detection of boiling in LMFBRs: an estimate of sensitivity derived from experiments during the commissioning of PFR, 4:38696
PFR REACTOR/STEAM SYSTEMS
Water chemistry in the Dounreay prototype fast reactor (PFR) power station, 4:38690
PHAGES
See BACTERIOPHAGES
PHENOL/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
PHENOL/DECOMPOSITION
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
PHENOLS
See also CRESOLS
PHENOL
PHENOLS/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PHENOLS/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PHILIPPINES/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
PHOSPHATE ROCKS/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
PHOSPHATE ROCKS/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
PHOSPHATES/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
PHOTOCHEMICAL OXIDANTS/BIOLOGICAL EFFECTS
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)
PHOTODETECTORS/TIME RESOLUTION
Picosecond photodetector for 257 nm to 1 μm laser pulses, 4:39296
PHOTODISINTEGRATION
See PHOTONUCLEAR REACTIONS
PHOTON-ATOM COLLISIONS/BREMSSTRAHLUNG
Inverse bremsstrahlung absorption rate in an intense laser field, 4:39796 (UCRL-13965)
PHOTON-ATOM COLLISIONS/ENERGY TRANSFER
Inverse bremsstrahlung absorption rate in an intense laser field, 4:39796 (UCRL-13965)
PHOTON-PHOTON INTERACTIONS/DIFFERENTIAL CROSS SECTIONS
Production of jets and single particles at large transverse momentum in photon-photon collisions, 4:39842
PHOTON-PHOTON INTERACTIONS/QUANTUM CHROMODYNAMICS
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
PHOTONS/PARTICLE PRODUCTION
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
PHOTONUCLEAR REACTIONS/KNOCK-OUT REACTIONS
Isobars and the medium-energy (γ,p) reaction, 4:39888
PHOTONUCLEAR REACTIONS/PHOTOPRODUCTION
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
PHOTONUCLEAR REACTIONS/TOTAL CROSS SECTIONS
Measurement of shadowing in photon-nucleus total cross sections from 20 to 185 GeV, 4:39817
PHOTOSPHERE/MAGNETIC FIELDS
A study of large-scale solar magnetic and velocity fields, 4:39745 (N-78-29027)
PHOTOSYNTHESIS/BIOLOGICAL PATHWAYS
Biological solar energy conversion approaches to overcome yield stability and product limitations. Progress report no. 6, 1 October 1977-31 March 1978, 4:39555 (PB-284823)
PHOTOVOLTAIC POWER PLANTS
See also SOLAR CELL ARRAYS
PHOTOVOLTAIC POWER PLANTS/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
PHOTOVOLTAIC POWER SUPPLIES/COST
Cost of photovoltaic energy systems as determined by balance-of-system costs, 4:38380 (N-78-27539)
PHOTOVOLTAIC POWER SUPPLIES/DESIGN
Description of the University of Texas at Arlington Solar Energy Research Facility photovoltaic/thermal residential system, 4:38397 (COO-4577-5)
PHOTOVOLTAIC POWER SUPPLIES/ECONOMIC ANALYSIS
Economic analysis of grid-connected residential solar photovoltaic power systems, 4:38377 (MIT-EL-78-007)
PHOTOVOLTAIC POWER SUPPLIES/SOCIAL IMPACT
Social assessment of on-site solar energy technologies. Topical report, 4:38366 (HCP/R4040-02)

PHTHALATES/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PHTHALATES/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PHYSICAL PROTECTION DEVICES
See also SECURITY SEALS
PHYSICAL PROTECTION DEVICES/DESIGN
Multiple application coded switch development report, 4:39260 (SAND-79-0329)
PHYSICS
See also HIGH ENERGY PHYSICS
NUCLEAR PHYSICS
SOLID STATE PHYSICS
PHYSICS/MEETINGS
Bumnentagung 1978, 4:39220 (AED-Conf-78-150-004)
PHYTOHEMAGGLUTININ/BIOLOGICAL EFFECTS
Lymphoblastogenesis in response to phytohemagglutinin in radium patients: quantitative aspects and reproducibility (^{226}Ra), 4:39676 (ANL-78-65(Pt.2))
PHYTOPLANKTON
See also ALGAE
PHYTOPLANKTON/POPULATION DYNAMICS
Preliminary report. R/V Thomas G. Thompson cruise TT-122 (Phytoplankton distribution and organic matter sedimentation rate data collected off of Washington Coast), 4:39611 (DOE/EV-75027-58)
PHYTOPLANKTON/PRODUCTIVITY
Preliminary report. R/V Thomas G. Thompson cruise TT-122 (Phytoplankton distribution and organic matter sedimentation rate data collected off of Washington Coast), 4:39611 (DOE/EV-75027-58)
PICKERING-1 REACTOR/PRIMARY COOLANT CIRCUITS
Radioactivity buildup in Pickering nuclear generating station heat transport system, 4:38655
PICKERING-1 REACTOR/RADIOACTIVITY TRANSPORT
Radioactivity buildup in Pickering nuclear generating station heat transport system, 4:38655
PIGMENTS
See also HEMOGLOBIN
PIGMENTS/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PIGMENTS/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
PILOT PLANTS/ENVIRONMENTAL EFFECTS
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
PINNING FORCE
See MAGNETIC FLUX
PINS (FUEL)
See FUEL PINS
PION BEAMS/RADIOTHERAPY
Initial performance of the PIGMI prototype (Pion Generator for Medical Irradiations), 4:39448 (LA-UR-79-658)
PION MINUS REACTIONS/CHARGE-EXCHANGE REACTIONS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
PION MINUS REACTIONS/ELASTIC SCATTERING
π^+ and π^- elastic scattering from ^{40}Ca at 65 MeV (Differential cross sections, preliminary results), 4:39903 (LA-UR-79-839)
PION MINUS REACTIONS/PARTICLE PRODUCTION
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
PION MINUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Low energy PI super plus /sub p/ elastic scattering (Preliminary data, differential cross sections 29.1 to 89.4 MeV), 4:39832 (LA-UR-79-893)
PION MINUS-PROTON INTERACTIONS/PARTICLE PRODUCTION
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
PION PLUS REACTIONS/ELASTIC SCATTERING
π^+ and π^- elastic scattering from ^{40}Ca at 65 MeV (Differential cross sections, preliminary results), 4:39903 (LA-UR-79-839)
Low energy π^+ scattering from light nuclei, 4:39896
PION PLUS REACTIONS/INELASTIC SCATTERING
Low energy π^+ scattering from light nuclei, 4:39896
PION PLUS-PROTON INTERACTIONS/CROSS SECTIONS
π^+ structure information from a jet experiment, 4:39826
PION PLUS-PROTON INTERACTIONS/ELASTIC SCATTERING
Low energy PI super plus /sub p/ elastic scattering (Preliminary data, differential cross sections 29.1 to 89.4 MeV), 4:39832 (LA-UR-79-893)
PION PLUS-PROTON INTERACTIONS/FINAL-STATE INTERACTIONS
ΛK and ΣK systems observed in π^+ interactions at 10.3 GeV/c (Peripheral phase space, broad theshold enhancements), 4:39864
PION PLUS-PROTON INTERACTIONS/SCATTERING AMPLITUDES
Amplitude analysis of the reaction $\pi^+ p \rightarrow rho^0 \Delta^{++}$ at 3.75 GeV/c (Angular distributions), 4:39862
PION REACTIONS/POTENTIAL SCATTERING
Effect of short-range correlations in the second order pion-carbon optical potential (Differential and total cross sections, 40 to 280 MeV, pion propagator effects), 4:39889
PIONIC ATOMS/RESEARCH PROGRAMS
Pion-nucleon interaction and mesonic atoms. Progress report, 1 February 1978-31 January 1979 (Summaries of research activities at Univ. Wyoming), 4:39829 (COO-2197-63)
PION-NUCLEON INTERACTIONS/RESEARCH PROGRAMS
Pion-nucleon interaction and mesonic atoms. Progress report, 1 February 1978-31 January 1979 (Summaries of research activities at Univ. Wyoming), 4:39829 (COO-2197-63)
PIONS
See also PIONS MINUS
PIONS NEUTRAL
PIONS PLUS
PIONS/PARTICLE PRODUCTION
Quantum-chromodynamic predictions for inclusive spin-spin asymmetries at large transverse momentum, 4:39867
Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target, 4:39868
PIONS/RADIATIVE DECAY
Determination of the axial vector form factor in the radiative decay of the pion (Branching ratio), 4:39847
PIONS MINUS/MULTIPLE PRODUCTION
Multipion production in nuclear collisions, 4:39934 (LBL-8758)
PIONS NEUTRAL/PARTICLE PRODUCTION
Measurement of inclusive $\pi 0$ production at large p/sub T/ from p-p collisions at the CERN ISR (Cross sections, 30.7 to 62.4 GeV), 4:39824 (COO-2232A-68)
PIONS PLUS/STRUCTURE FUNCTIONS
π^+ structure information from a jet experiment, 4:39826
PIPE JOINTS/DESIGN
Flexible connectors, 4:38184 (CONF-7611113-)
PIPELINE QUALITY GAS
See HIGH BTU GAS
PIPELINES
See also NATURAL GAS DISTRIBUTION SYSTEMS
SLURRY PIPELINES
PIPELINES/CORROSION PRODUCTS
Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits, 4:38628
PIPELINES/COUPLINGS
Flexible connectors, 4:38184 (CONF-7611113-)
PIPELINES/DRILLING RIGS
Boring proves exciting way to cross river, 4:38185 (CONF-7611113-)
PIPELINES/INSTALLATION
Boring proves exciting way to cross river, 4:38185 (CONF-7611113-)
PIPELINES/MEETINGS
12th annual pipeline operation and maintenance institute. Petroleum Institute booklet: selected papers of the Heart of America, 4:38183 (CONF-7611113-)
PISTONS/DESIGN
Adjustable expandable cryogenic piston and ring (Patent), 4:39274
PISTONS/RINGS
Piston ring scuffing, 4:39078
PITCHES/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
PLANETS
See also EARTH PLANET
JUPITER PLANET
PLANETS/BIBLIOGRAPHIES
A bibliography of planetary geology principal investigators and their associates, 1976-1978, 4:39756 (N-78-28027)
PLANKTON
See also PHYTOPLANKTON
PLANKTON/SAMPLING
Horizontal undependability in the planktonic environment, 4:39610

PLANTS
See also ALGAE
AQUATIC ORGANISMS
BIOMASS
CACTI
SHRUBS
TREES
WEEDS
PLANTS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
PLANTS/PRODUCTIVITY
Genetic modification and plant productivity, 4:39651
PLANTS/RADIONUCLIDE MIGRATION
Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL-1948)
PLANTS (INDUSTRIAL)
See INDUSTRIAL PLANTS
PLANTS (PILOT)
See PILOT PLANTS
PLANTS (POWER)
See POWER PLANTS
PLASMA
See also BEAM-PLASMA SYSTEMS
INHOMOGENEOUS PLASMA
LASER-PRODUCED PLASMA
PLASMA/IMPURITIES
Effect of current profile evolution on plasma-limiter interaction and the energy confinement time, 4:39980 (PPPL-1534)
PLASMA/IONIC COMPOSITION
Mass spectrometeric determination of negative and positive ion concentrators in coal-fired MHD plasmas, 4:38982 (CONF-781009-)
PLASMA/LASER RADIATION
Laser-plasma coupling, 4:40015 (UCRL-81896)
PLASMA/MATHEMATICAL MODELS
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
PLASMA/MEETINGS
Controlled fusion and plasma physics. Vol. II, 4:40003 (INIS-mf-4125)
Controlled fusion and plasma physics. Workshop on stellarators, 4:40004 (INIS-mf-4324)
PLASMA/RESEARCH PROGRAMS
Experimental and theoretical activities in plasma physics. Annual status report, 31 December 1976, 4:39976 (N-78-28954)
PLASMA/THERMODYNAMICS
LLL dynamic high pressure experiments, 4:39981 (UCRL-82272)
PLASMA ARC WELDING
TIG and plasma welding (Book), 4:39100
PLASMA BEAM INJECTION
Experimental test of the feasibility of heating tokamaks by gun injection, 4:40012
PLASMA CONFINEMENT/ALPHA PARTICLES
Plasma flow driven by fusion-generated alpha particles, 4:39965 (N-78-27917)
PLASMA CONFINEMENT/MAGNETIC FIELDS
Twisting modes, 4:39991
PLASMA DIAGNOSTICS
Development of working fluid diagnostics for large MHD generators by means of submillimeter lasers, 4:38981 (CONF-781009-)
PLASMA DIAGNOSTICS/ABSORPTION SPECTROSCOPY
Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry, 4:38980 (CONF-781009-)
PLASMA DIAGNOSTICS/CORRELATION FUNCTIONS
Diagnostics of combustion products plasma based on its fluctuation characteristics, 4:38979 (CONF-781009-)
PLASMA DIAGNOSTICS/FLUORESCENCE
Diagnosis of high-temperature hydrogen plasma by the resonance fluorescence method, 4:39975
PLASMA DIAGNOSTICS/LEADING ABSTRACT
High-temperature plasma diagnostics, 4:39972 (INIS-mf-4403)
PLASMA DIAGNOSTICS/LUMINOSITY
Plasma luminosity fluctuations as a diagnostic tool, 4:38984
PLASMA DIAGNOSTICS/MICHELSON INTERFEROMETER
Measurement of electron concentration and mobility in slag-laden MHD flows by submollimeter interferometry, 4:38980 (CONF-781009-)
PLASMA DIAGNOSTICS/SPECTROSCOPY
Spectroscopic measurements of temperature, electron density, and temperature fluctuations, 4:38965 (CONF-781009-)
PLASMA DIAGNOSTICS/VACUUM SYSTEMS
Shiva and Argus target diagnostics vacuum systems, 4:40021
PLASMA EXPANSION/HYDRODYNAMICS
Self-similar power-driven expansion into vacuum, 4:40017
PLASMA EXPANSION/THERMONUCLEAR REACTORS
Self-similar power-driven expansion into vacuum, 4:40017
PLASMA HEATING
See also BEAM INJECTION HEATING
SHOCK HEATING
PLASMA HEATING/BEAM INJECTION HEATING
Properties of an intense 40-kV neutral beam injector, 4:40011
PLASMA INSTABILITY
See also PLASMA MICROINSTABILITIES
PLASMA INSTABILITY/ELECTROMAGNETIC FIELDS
Twisting modes, 4:39991
PLASMA INSTABILITY/ELECTRON BEAMS
Nonlinear development of an electromagnetic filamentation instability, 4:39988
PLASMA INSTABILITY/GUIDING-CENTER APPROXIMATION
Stability properties of an anisotropic guiding center plasma and relation with the Suydam function, 4:39990
PLASMA INSTABILITY/MAGNETOHYDRODYNAMICS
Stable equilibrium statistical states for spheromaks, 4:39989
PLASMA INSTABILITY/NONLINEAR PROBLEMS
Raman side-scatter instability in nonuniform plasma, 4:39994
PLASMA INSTABILITY/PLASMA FILAMENT
Nonlinear development of an electromagnetic filamentation instability, 4:39988
PLASMA INSTABILITY/RAMAN EFFECT
Raman side-scatter instability in nonuniform plasma, 4:39994
PLASMA INSTABILITY/SUYDAM CRITERION
Stability properties of an anisotropic guiding center plasma and relation with the Suydam function, 4:39990
PLASMA INSTABILITY/TURBULENCE
Stable equilibrium statistical states for spheromaks, 4:39989
PLASMA MICROINSTABILITIES
See also CYCLOTRON INSTABILITY
DRIFT INSTABILITY
PLASMA MICROINSTABILITIES/BETA RATIO
Finite beta effects on the drift-cyclotron instability, 4:39993
PLASMA PRESSURE/ANISOTROPY
Stability properties of an anisotropic guiding center plasma and relation with the Suydam function, 4:39990
PLASMA WAVES/EIGENVALUES
A new treatment of localized modes in inhomogeneous Vlasov plasma, 4:39996 (N-78-27915)
PLASMA WAVES/MAGNETOHYDRODYNAMICS
Interpretation of the ponderomotive potential for a magnetized particle in a low-frequency wave, 4:40000
PLASMA WAVES/PLASMA HEATING
Nonlinear evolution of lower hybrid waves, 4:39999
PLASTICS
See also POLYACRYLATES
POLYETHYLENES
POLYSTYRENE
PLASTICS/CHEMICAL COMPOSITION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
PLASTICS/MACHINING
Precision machining vs. optical process, 4:39096 (UCRL-82528)
PLASTICS/THERMAL DEGRADATION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
PLASTICS/VAPOR DEPOSITED COATINGS
Deposition of aluminum-copper alloy on laminated polyimide substrates from a RF induction source, 4:39331 (BDX-613-2173)
PLATINUM/ATOM COLLISIONS
Reactive and nonreactive scattering of modulated molecular beams from well characterized platinum single crystal surfaces (Mechanism, rainbow scattering, angular distribution), 4:39772 (LBL-7687)
PLATINUM/CATALYTIC EFFECTS
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
Properties of supported metal catalysts, 4:39226 (LBL-8975)
PLATINUM/SORPTIVE PROPERTIES
Effects of metal-support interactions and metal crystallite size on carbon monoxide hydrogenation reactions, 4:38314 (LBL-8975)
PLATINUM BASE ALLOYS/CHEMICAL COMPOSITION
Selected advances in materials research, 4:39106 (CONF-790343-1)
PLATINUM COMPLEXES/ELECTRIC CONDUCTIVITY
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)

PLATINUM COMPLEXES/SYNTHESIS
Synthesis and properties of several new molecular conductors. Technical report, 4:39217 (AD-A-058697)
PLT REACTORS/EMISSION SPECTRA
Dielectronic satellite spectrum of helium-like iron (Fe XXV), 4:39973 (PPPL-1538)
PLT REACTORS/IMPURITIES
Effect of current profile evolution on plasma-limiter interaction and the energy confinement time, 4:39980 (PPPL-1534)
Hydrogen isotope trapping in materials exposed in PLT, 4:40006 (PPPL-1537)
PLT REACTORS/NEUTRON EMISSION
Neutron emission profiles in the beam-heated Princeton large tokamak, 4:39977
PLT REACTORS/PRESSURE VESSELS
Observations of changes in residual gas and surface composition with discharge cleaning in PLT, 4:40024
PLUGGING/MATERIALS
Effect of mineral fillers on the properties of plugging materials, 4:38150
PLUMES
Cooling towers, design and plume behavior, 4:38578
Cooling tower plume research U.S. Environmental Protection Agency, 4:39589
PLUMES/DATA ACQUISITION
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
PLUMES/DIFFUSION
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
PLUTONIUM/ADSORPTION
Adsorption of neptunium and plutonium on metal phosphites, 4:38252 (MLM-2595)
PLUTONIUM/ENVIRONMENTAL EFFECTS
Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc, 4:39601 (CONF-781105-100)
PLUTONIUM/PHOTOCHEMICAL REACTIONS
Photochemistry of the actinides, 4:39253 (CONF-790415-21)
PLUTONIUM/RECOVERY
Recovery of plutonium from insulation, scrap glass, and sand-slag residues, 4:38257 (RFP-2835)
PLUTONIUM 238/BIOLOGICAL RADIATION EFFECTS
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
PLUTONIUM 238/INTRAVENOUS INJECTION
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
PLUTONIUM 238/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
PLUTONIUM 238/RADIOISOTOPE HEAT SOURCES
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM-6660)
PLUTONIUM 239/BIOLOGICAL RADIATION EFFECTS
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
PLUTONIUM 239/BLOOD-PLASMA CLEARANCE
Blood content and excretory plasma clearance of plutonium 10^4 days after injection (^{239}Pu), 4:39687 (ANL-78-65(Pt.2))
PLUTONIUM 239/ECONOMICS
Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP, 4:38225
PLUTONIUM 239/INTRAVENOUS INJECTION
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
PLUTONIUM 239/ISOTOPE PRODUCTION
Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP, 4:38225
PLUTONIUM 239/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
PLUTONIUM 239/QUANTITATIVE CHEMICAL ANALYSIS
Intercomparison of plutonium-239 measurements. Final report, 4:39201 (PB-285438)
PLUTONIUM 239/RADIOECOLOGICAL CONCENTRATION
Blood content and excretory plasma clearance of plutonium 10^4 days after injection (^{239}Pu), 4:39687 (ANL-78-65(Pt.2))
PLUTONIUM 239/TISSUE DISTRIBUTION
Distribution of injected plutonium in the skeleton and certain soft tissues (^{239}Pu), 4:39688 (ANL-78-65(Pt.2))
PLUTONIUM 239 TARGET/NEUTRON REACTIONS
Absolute neutron fission cross sections of ^{235}U, ^{239}U, and ^{239}Pu at 13.9 and 14.6 MeV, 4:39927
PLUTONIUM 242 TARGET/NEUTRON REACTIONS
Evaluation of n + ^{242}Pu reactions from 10 keV to 20 MeV (Data compilation, cross sections, angular distributions), 4:39922 (LA-UR-78-3062)
Summary documentation for ^{242}Pu (10 keV to 20 MeV), 4:39921 (LA-7663-MS)
PLUTONIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
PLUTONIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
PLUTONIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
PLUTONIUM DIOXIDE/CRITICALITY
Criticality data for $(Pu,U)O_2$ fuel, 4:39275 (AECL-5807(rev.1))
PLUTONIUM DIOXIDE/PHYSICAL RADIATION EFFECTS
Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA-1543-FP)
PLUTONIUM DIOXIDE/PNEUMATIC TRANSPORT
State-of-the-art survey of pneumatic powder transport, 4:38233 (WCAP-9189)
PLUTONIUM ISOTOPES/AVAILABILITY
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
PLUTONIUM ISOTOPES/HEALTH HAZARDS
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
PLUTONIUM ISOTOPES/TISSUE DISTRIBUTION
Radiological and Environmental Research Division annual report, July 1977-June 1978, 4:39670 (ANL-78-65(Pt.2))
PNA
See POLYCYCLIC AROMATIC HYDROCARBONS
PNEUMATIC TRANSPORT/TECHNOLOGY ASSESSMENT
State-of-the-art survey of pneumatic powder transport, 4:38233 (WCAP-9189)
POLAND/POWER SYSTEMS
Problems of country power system automation (In Polish), 4:38615
POLAR SUBSTORMS
See MAGNETIC BAYS
POLARIZED BEAMS/SPIN ORIENTATION
800-MeV spin precessor for polarized H^- beams using H^- to H^0 stripping, 4:39407 (LA-UR-79-751)
POLLUTION
(For nonradioactive pollution only; see also CONTAMINATION.)
See also AIR POLLUTION
CHEMICAL EFFLUENTS
LAND POLLUTION
THERMAL POLLUTION
WATER POLLUTION
POLLUTION/BIOLOGICAL EFFECTS
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO-2874-46)
POLLUTION/COORDINATED RESEARCH PROGRAMS
Who's Who III in the Interagency Energy/Environment R and D Program (Directory of EPA sponsored projects), 4:38892 (PB-284228)
Who's Who IV in the Interagency Energy/Environment R and D Program, 4:38893 (PB-284375)
POLLUTION/DATA ACQUISITION
Systems for rapid ranking of environmental pollutants: selection of subjects for scientific and technical assessment reports. Final report, 4:39553 (PB-284338)
POLLUTION/DATA PROCESSING
Systems for rapid ranking of environmental pollutants: selection of subjects for scientific and technical assessment reports. Final report, 4:39553 (PB-284338)
POLLUTION/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
POLLUTION CONTROL
See also AIR POLLUTION CONTROL
WATER POLLUTION CONTROL
POLLUTION CONTROL/RESEARCH PROGRAMS
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
POLLUTION REGULATIONS/DECISION MAKING
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)

POLONIUM 210/DELAYED RADIATION EFFECTS
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL-78-65(Pt.2))
POLONIUM 210/INGESTION
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL-78-65(Pt.2))
POLONIUM 210/RADIOECOLOGICAL CONCENTRATION
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
POLYACRYLATES/RHEOLOGY
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978-December 31, 1979, 4:39236 (BETC-5603-6)
POLYACRYLATES/SYNTHESIS
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978-December 31, 1979, 4:39236 (BETC-5603-6)
POLYAMIDES/PHYSICAL RADIATION EFFECTS
Simulation of space radiation effects on polyimide film materials for high temperature applications. Final report, 4:39197 (N-78-28604)
POLYAMIDES/RHEOLOGY
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978-December 31, 1979, 4:39236 (BETC-5603-6)
POLYAMIDES/SYNTHESIS
Improved polymers for enhanced oil recovery: synthesis and rheology (V). Progress report, October 1, 1978-December 31, 1979, 4:39236 (BETC-5603-6)
POLYATOMIC MOLECULES/DISSOCIATION
Rotational distributions from photodissociations. I. Linear triatomic molecules, 4:39768
POLYATOMIC MOLECULES/ELECTRON-MOLECULE COLLISIONS
Negative ions of polyatomic molecules (Resonance, anions, electron dissociative attachment, electron capture, potential energy, cross sections, yields, lifetime), 4:39783 (CONF-790344-1)
POLYATOMIC MOLECULES/PHOTON-MOLECULE COLLISIONS
Rotational distributions from photodissociations. I. Linear triatomic molecules, 4:39768
POLYATOMIC MOLECULES/ROTATIONAL STATES
Rotational distributions from photodissociations. I. Linear triatomic molecules, 4:39768
POLYCYCLIC AROMATIC HYDROCARBONS/BIOLOGICAL ACCUMULATION
Synthetic Fuels Program, 4:38090 (ORNL-5508)
POLYCYCLIC AROMATIC HYDROCARBONS/CARCINOGENESIS
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415-31)
POLYCYCLIC AROMATIC HYDROCARBONS/DIFFUSION
Diffusion of polyaromatics in catalyst supports, 4:39240 (LBL-8975)
POLYCYCLIC AROMATIC HYDROCARBONS/TOXICITY
Synthetic Fuels Program, 4:38090 (ORNL-5508)
POLYETHYLENES/LATENT HEAT STORAGE
Energy storage for solar air conditioning applications utilizing a form-stable, high density polyethylene pellet bed, 4:38506 (MLM-2598(OP))
POLYMER FLOODING
See MICROEMULSION FLOODING
POLYMERASES/BIOLOGICAL REPAIR
Enhancement of deoxyribonucleic acid polymerase I-directed repair synthesis in toluene-treated Escherichia coli after growth in the presence of low levels of N-methyl-N'-nitro-N-nitrosoguanidine, 4:39642
POLYMERS
See also PLASTICS
SILICONES
POLYMERS/RHEOLOGY
Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977-September 1978, 4:39235 (BETC-5603-5)
POLYMERS/SYNTHESIS
Improved polymers for enhanced oil recovery: synthesis and rheology. First annual report for the period October 1977-September 1978, 4:39235 (BETC-5603-5)
POLYOLEFINS
See also POLYETHYLENES
POLYSTYRENE
POLYOLEFINS/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
POLYOLEFINS/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
POLYSTYRENE/CHARGED-PARTICLE TRANSPORT
Inverse mean free path, stopping power, csda range, and straggling in polystyrene for electrons of energy < or = 10 keV. Interim technical report, 4:39939 (AD-A-057881)
POLYSTYRENE/CORRELATIONS
Static correlations in semidilute polymer solutions, 4:39181 (CONF-790415-24)
POLYSULFIDES
See SULFIDES
PONDS
See also COOLING PONDS
SOLAR PONDS
See LAKES
PONDS/TEMPERATURE CONTROL
Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report, 4:39041 (PB-285709)
PONDS (COOLING)
See COOLING PONDS
POSTULATED PARTICLES
See also QUARKS
POSTULATED PARTICLES/LIFETIME
Search for new massive particles (400 GeV, cross sections, upper limit), 4:39828
POTASSIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
POTASSIUM/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
POTASSIUM/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
POTASSIUM/ION EXCHANGE
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
POTASSIUM CARBONATES/CATALYTIC EFFECTS
Conversion of forest residues to a methane-rich gas, 4:38322
POTASSIUM COMPOUNDS/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
POTASSIUM COMPOUNDS/RADIOMETRIC ANALYSIS
Determining the water-insoluble residue in potassium salts by gamma surveying, 4:38204
POTENTIALS
Analytic coherent states for generalized potentials, 4:39802 (LA-UR-79-218)
POTT-BROCHE PROCESS/CHEMISTRY
Chemical structures and reactivities of coal as an organic natural product, 4:38071 (CONF-790415-25)
POULTRY
See FOWL
POWER DEMAND/FORECASTING
Need for better forecasting, 4:38935
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
Time series forecasting of utility load duration curves, 4:38933
POWER GENERATION/FORECASTING
Short term coal demand model. Final report, 4:38127 (DOE/TIC-10089)
POWER PLANTS
See also DUAL-PURPOSE POWER PLANTS
FOSSIL-FUEL POWER PLANTS
HYDROELECTRIC POWER PLANTS
MHD POWER PLANTS
NUCLEAR POWER PLANTS
THERMONUCLEAR POWER PLANTS
TIDAL POWER PLANTS
POWER PLANTS/CONTROL SYSTEMS
Design and testing of power plant controls by means of simulation, 4:38568 (AED-Conf-78-155-024)
Increased productivity in power plants by the computer-based information system PRAUT, 4:38567 (AED-Conf-78-155-017)
POWER PLANTS/ENVIRONMENTAL EFFECTS
Final environmental impact report on the long range energy program for the California State Water Project. Final report, 4:38876 (PB-283822)
POWER PLANTS/WASTE HEAT
Heat releases of power plants, 4:39592
POWER PLANTS/WASTE HEAT UTILIZATION
Overview of waste heat utilization techniques, 4:39039 (CONF-790443-2)

POWER REACTORS
See also BOR-60 REACTOR
CALHOUN-1 REACTOR
CLINCH RIVER BREEDER REACTOR
DESALINATION REACTORS
DRESDEN-1 REACTOR
EBR-2 REACTOR
KNK REACTOR
MILLSTONE-2 REACTOR
N-REACTOR
PEC BRASIMONE REACTOR
PFR REACTOR
PICKERING-1 REACTOR
PROCESS HEAT REACTORS
RANCHO SECO-1 REACTOR
RANCHO SECO-2 REACTOR
SGHWR REACTOR
SNR-1 REACTOR
TARAPUR-1 REACTOR
TARAPUR-2 REACTOR
VRAIN REACTOR
WWER TYPE REACTORS
ZION-1 REACTOR
ZION-2 REACTOR

POWER REACTORS/CONSTRUCTION
Technology of reactor construction (Book; in Russian), 4:38623

POWER REACTORS/HEAT EXCHANGERS
Vibration of heat exchange components in liquid and two-phase cross-flow, 4:38731 (AECL-6184)

POWER REACTORS/LOOSE PARTS MONITORING
On-line computerized reactor noise, vibration and loose parts monitoring system, 4:38747

POWER REACTORS/REACTOR CONTROL SYSTEMS
Nuclear power plant operational diagnostics and control, 4:38756

POWER REACTORS/REACTOR INSTRUMENTATION
On-line computerized reactor noise, vibration and loose parts monitoring system, 4:38747

POWER REACTORS/THORIUM CYCLE
Nuclear energy from thorium. An introduction, 4:38723 (INS-R-230)

POWER SUBSTATIONS/EQUIPMENT PROTECTION DEVICES
A triggered co-ordinating gap for metalclad substations, 4:38611 (N-78-28360)

POWER SUBSTATIONS/OVERVOLTAGE
A triggered co-ordinating gap for metalclad substations, 4:38611 (N-78-28360)

POWER SUPPLIES/SWITCHES
Tests of vacuum interrupters for the Tokamak Fusion Test Reactor, 4:40009 (LA-7759-MS)

POWER SYSTEMS/AUTOMATION
Methodology of determination in the estimation of power system automation effects (In Polish), 4:38616
Problems of country power system automation (In Polish), 4:38615

POWER SYSTEMS/CONTROL SYSTEMS
Microprocessor oriented data acquisition and control system for power system control, 4:38617

POWER SYSTEMS/LOAD MANAGEMENT
Time series forecasting of utility load duration curves, 4:38933

POWER SYSTEMS/MAGNETIC ENERGY STORAGE EQUIPMENT
Security assessment of power systems including energy storage. Progress report, April 1-June 30, 1978, 4:38610 (COO-4206-5)

POWER SYSTEMS/PLANNING
Decomposition and probabilistic simulation in electric utility planning models. Technical report, 4:38609 (AD-A-058421)

POWER SYSTEMS/SECURITY
Security assessment of power systems including energy storage. Progress report, April 1-June 30, 1978, 4:38610 (COO-4206-5)

POWER TRANSMISSION
See also MICROWAVE POWER TRANSMISSION

POWER TRANSMISSION/COMPARATIVE EVALUATIONS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)

POWER TRANSMISSION LINES/TECHNOLOGY ASSESSMENT
High voltage dc for resource development, 4:38620

POWER TRANSMISSION TOWERS/DYNAMIC LOADS
Response of a latticed transmission tower to wind. Final report, 4:38612 (PB-285123)

POWER TRANSMISSION TOWERS/STRESS ANALYSIS
Analytical modeling techniques of a lattice-type tower. Master's thesis, 4:38613 (PB-285190)

POWER-COOLING-MISMATCH ACCIDENTS/FUEL ELEMENT FAILURE
Behavior of a failed fuel rod during film boiling operation (PWR), 4:38797 (CONF-790602-3)
Fuel rod behavior in a nine-rod bundle tested in film boiling (PWR), 4:38796 (CONF-790602-2)

POWERED SUPPORTS/REMOTE CONTROL
Control of self-advancing mine roof supports (Patent), 4:38105

PRASEODYMIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)

PRASEODYMIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)

PRASEODYMIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)

PRECIPITATIONS (ATMOSPHERIC)
See ATMOSPHERIC PRECIPITATIONS

PREPARATION (SAMPLE)
See SAMPLE PREPARATION

PRESSURE (1000 ATM AND ABOVE)
See VERY HIGH PRESSURE

PRESSURE MEASUREMENT
Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB-284041)

PRESSURE VESSELS/CLEANING
Observations of changes in residual gas and surface composition with discharge cleaning in PLT, 4:40024

PRESSURE VESSELS/CORROSION PROTECTION
Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems (HTGR), 4:38642 (ORNL/TM-6478)

PRESSURE VESSELS/FAILURES
Assessment of the integrity of PWR pressure vessels. A U.K. study group report, 4:38805 (INIS-mf-4506)
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf-4506)

PRESSURE VESSELS/FRACTURE PROPERTIES
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)

PRESSURE VESSELS/LEAK TESTING
Measurement error in pressure-decay leak testing, 4:39259 (ORNL/TM-6855)

PRESSURE VESSELS/MEASURING INSTRUMENTS
Principles of measurement and of safety surveillance for the PCPV/helium-loop, 4:38743 (SGAE-2820)

PRESSURE VESSELS/PERFORMANCE TESTING
Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems (HTGR), 4:38642 (ORNL/TM-6478)

PRESSURE VESSELS/RESIDUAL STRESSES
Estimation of residual stresses in reactor pressure vessel steel specimens clad by stainless steel strip electrodes, 4:39132
Residual stresses in a weldment of pressure vessel steel, 4:38746

PRESSURE VESSELS/STRESS ANALYSIS
Structural model testing for prestressed concrete pressure vessels: a study of grouted vs nongrouted posttensioned prestressing tendon systems (HTGR), 4:38642 (ORNL/TM-6478)

PRESSURE VESSELS/WELDED JOINTS
Residual stresses in a weldment of pressure vessel steel, 4:38746

PRESSURIZED WATER REACTORS
See PWR TYPE REACTORS

PRIMARY BATTERIES/IMPACT TESTS
Testing of a lithium battery for use in an earth penetrator (Li/V_2O_5), 4:38847 (SAND-78-1364)

PRIMARY BATTERIES/PERFORMANCE TESTING
Testing of a lithium battery for use in an earth penetrator (Li/V_2O_5), 4:38847 (SAND-78-1364)

PRIMARY BATTERIES/WASTE DISPOSAL
Investigation of the environmental consequences of disposal of the lithium organic-electrolyte/SO_2 battery. Final report Sep 76-Jan 78, 4:39596 (AD-A-059512)

PRIMARY COOLANT CIRCUITS/CLEANING
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)

PRIMARY COOLANT CIRCUITS/CORROSION
Sodium technology progress report, October-December 1978 (LMFBR), 4:38673 (HEDL-TME-78-93)

PRIMARY COOLANT CIRCUITS/CORROSION PRODUCTS
Options for radiation field reduction: their potential and benefit to cost ratio, 4:38660
PRIMARY COOLANT CIRCUITS/ELECTROMAGNETIC PUMPS
Electromagnetic pumps for fast reactors primary cooling circuits, 4:38683 (NIIEFA-A-0340)
PRIMARY COOLANT CIRCUITS/FILTERS
High flow, high temperature magnetic filtration of the primary heat transport coolant of the CANDU power reactors, 4:38653
PRIMARY COOLANT CIRCUITS/FISSION PRODUCT RELEASE
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978 (PWR; BWR; primary system reflooding following LOCA), 4:38816 (NUREG/CR-0697)
PRIMARY COOLANT CIRCUITS/HEAT TRANSFER
Possibilities to determine the heat transfer between nuclear fuel elements and the coolant in a sodium cooled reactor during normal power operation, 4:38680 (KFK-2619)
PRIMARY COOLANT CIRCUITS/PIPELINES
Effect of nickel hydroxde injections on the mass transfer of corrosion products in high temperature, high pressure water circuits, 4:38628
PRIMARY COOLANT CIRCUITS/RADIOACTIVITY TRANSPORT
Sodium technology progress report, October-December 1978 (LMFBR), 4:38673 (HEDL-TME-78-93)
PRIMARY COOLANT CIRCUITS/TWO-PHASE FLOW
Analytical study of solids-gas two phase flow (HTGR), 4:38689 (UTNL-R-0046)
PRIMARY COSMIC RADIATION/CHARGE DISTRIBUTION
The charge and energy spectra of heavy cosmic ray nuclei (Z > 11, E between 650 and 1800 MeV/n), 4:39729 (N-78-29031)
PRIMARY COSMIC RADIATION/ENERGY SPECTRA
The charge and energy spectra of heavy cosmic ray nuclei (Z > 11, E between 650 and 1800 MeV/n), 4:39729 (N-78-29031)
PROCESS HEAT REACTORS
ADAM I - methanation pilot plant, 4:38716 (Juel-1433)
PROCESS HEAT REACTORS/DISTRICT HEATING
Heat extraction from nuclear power plants, 4:38714 (INIS-mf-4376)
PROCESS HEAT REACTORS/HEAT EXCHANGERS
Metallurgical problems of the He-to-He heat exchanger for advanced HTR's, 4:38719
PROCESS HEAT REACTORS/USES
High-temperature reactor, 4:38715 (INIS-mf-4494)
PROCESS SOLUTIONS/CHEMICAL ANALYSIS
Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976-July 1977, 4:38199 (PB-284027)
PROCESSING (DATA)
See DATA PROCESSING
PROCESSING (WASTES)
See WASTE PROCESSING
PRODUCTIVITY/GENETIC VARIABILITY
Genetic modification and plant productivity, 4:39651
PROFLAVINE/CRYSTAL STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR-3490-1574)
PROFLAVINE/MOLECULAR STRUCTURE
Visualization of drug-nucleic acid interactions at atomic resolution v. structure of two aminoacridine/dinucleoside monophosphate crystalline complexes, proflavine: 5-iodocytidylyl(3'-5') guanosine and acridine orange: 5-iodocytidylyl(3'-5') guanosine, 4:39245 (UR-3490-1574)
PROGRAMMING/OPTIMIZATION
Implementation and testing of optimization software, 4:40034 (DOE/TIC-10096)
PROGRAMMING LANGUAGES/COMPARATIVE EVALUATIONS
Computer language evaluation for MFTF SCDS, 4:39974 (UCID-18089)
PROGRAMMING LANGUAGES/MANUALS
Primer and user manual for a Fortran Language Interactive Processor (FLIP), 4:40033 (DOE/EIA-0103/25)
PROMETHAZINE
See AMINES
PROMPT NEUTRONS/ENERGY SPECTRA
Calculation of prompt fission neutron spectra, 4:39917 (LA-7722-PR)
PROPANE/COMBUSTION
Fundamental flame-speed measurements in combustion gases containing CF_3Br. WSS Paper No. 79-16, 4:39255 (UCRL-82181)
PROPANONE
See ACETONE
PROPENE
See PROPYLENE
PROPORTIONAL COUNTERS/DATA ACQUISITION SYSTEMS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
PROPORTIONAL COUNTERS/DATA ANALYSIS
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
PROPORTIONAL COUNTERS/OPERATION
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
PROPORTIONAL COUNTERS/PERFORMANCE
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
PROPYLENE/ELECTRON COLLISIONS
Electron impact spectra of some mono-olefinic hydrocarbonsa), 4:39775
PROSTHESES/CHEMICAL REACTIONS
Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB-284092)
PROTACTINIUM 231/DECAY
Late excretion of ^{231}Pa and its decay products, 4:39690 (ANL-78-65(Pt.2))
PROTACTINIUM 231/EXCRETION
Late excretion of ^{231}Pa and its decay products, 4:39690 (ANL-78-65(Pt.2))
PROTECTION
See SAFETY
PROTECTION (RADIATION)
See RADIATION PROTECTION
PROTECTIVE COATINGS/OPTICAL PROPERTIES
Measurements of material properties for solar cells. Final report, 7 February 1977-6 March 1978, 4:38388 (N-78-31531)
PROTECTIVE COATINGS/PHYSICAL RADIATION EFFECTS
Proton and electron irradiation of thermal control coatings and polymeric films. I. Experimental irradiations, 4:39184 (N-78-31252)
Proton and electron irradiation of thermal control coatings and polymeric films. II. Theoretical irradiations. Final report, 4:39185 (N-78-31253)
PROTEINS
See also GLOBULINS
PROTEINS/ADSORPTION
Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB-284092)
PROTEINS/BIOCHEMICAL REACTION KINETICS
Net biosynthesis of Antithrombin III by the isolated rat liver perfused for 12-24 hours. Compared with rat fibrinogen and α-2 (acute phase) globulin, Antithrombin III is not an acute phase protein, 4:39638 (UR-3490-1578)
PROTEINS/CHEMICAL REACTIONS
Study of the interaction of plasma proteins with prosthetic surfaces. IV. Annual report no. 4, 1 December 1975-30 November 1976, 4:39652 (PB-284092)
PROTON BEAMS/BEAM OPTICS
Progress in space charge lens development, 4:39423 (UCRL-81834)
PROTON BEAMS/BETATRON OSCILLATIONS
Proton cooling by radiation, 4:39418 (LBL-7574)
PROTON BEAMS/ELECTRON COOLING
Beam stability considerations during electron cooling, 4:39419 (LBL-7574)
Overview of beam cooling, 4:39409 (LBL-7574)
Relativistic electron cooling for high luminosity proton-anti proton colliding beams at very high energies, 4:39413 (LBL-7574)
PROTON BEAMS/FOCUSING
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
PROTON BEAMS/POWER RANGE 100-1000 GW
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
PROTON BEAMS/PULSES
Production of 0.5-TW proton pulses with a spherical focusing, magnetically insulated diode, 4:39780
PROTON BEAMS/STOCHASTIC PROCESSES
Overview of beam cooling, 4:39409 (LBL-7574)
PROTON BEAMS/SYNCHROTRON RADIATION
Proton cooling by radiation, 4:39418 (LBL-7574)
PROTON BEAMS/USES
Physics uses of intense proton beams at 10 to 20 GeV, 4:39454 (LA-UR-79-898)

PROTON REACTIONS/BREMSSTRAHLUNG
Differential cross section for proton-proton bremsstrahlung at 1.38 GeV/c, 4:39827
PROTON REACTIONS/ELASTIC SCATTERING
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
PROTON REACTIONS/FISSION
Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium, 4:39924
PROTON REACTIONS/FRAGMENTATION
Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium, 4:39924
Nucleosynthesis of Li, Be, and B: contributions from the p + ^{16}O reaction at 50-90 MeV, 4:39895
PROTON REACTIONS/INELASTIC SCATTERING
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
PROTON REACTIONS/KNOCK-OUT REACTIONS
Spallation of aluminum by 300 GeV protons, 4:39901
PROTON REACTIONS/TOTAL CROSS SECTIONS
Proton total reaction cross section measurements for /sup 40,44,48/Ca at 700 MeV, 4:39906
PROTON-ANTIPROTON INTERACTIONS/FRAGMENTATION
Hadronic fragmentation initiated by pointlike probes, 4:39849
PROTON-ANTIPROTON INTERACTIONS/INCLUSIVE INTERACTIONS
Hadronic fragmentation initiated by pointlike probes, 4:39849
PROTON-ANTIPROTON INTERACTIONS/RADIATION DETECTORS
Detectors; relation of detectors to proton-anti proton machines, 4:39455 (LBL-7574)
PROTON-DEUTERON INTERACTIONS/RESCATTERING
Rescattering corrections to spin-dependent proton-deuteron total cross sections, 4:39866
PROTON-DEUTERON INTERACTIONS/TOTAL CROSS SECTIONS
Rescattering corrections to spin-dependent proton-deuteron total cross sections, 4:39866
PROTON-PROTON INTERACTIONS/CORRELATIONS
Results on correlations and jets in high transverse momentum p-p collisions at the CERN ISR (VS= 62.4 GeV, 3 to 11 GeV/C), 4:39823 (COO-2232A-67)
PROTON-PROTON INTERACTIONS/CROSS SECTIONS
π^+ structure information from a jet experiment, 4:39826
PROTON-PROTON INTERACTIONS/FRAGMENTATION
Hadronic fragmentation initiated by pointlike probes, 4:39849
PROTON-PROTON INTERACTIONS/INCLUSIVE INTERACTIONS
Anomalous e^+e^- and $\mu^+\mu^-$ events produced in e^+e^- annihilation (Differential cross sections), 4:39846
Hadronic fragmentation initiated by pointlike probes, 4:39849
Measurement of inclusive π^0 production at large p/sub T/ from p-p collisions at the CERN ISR (Cross sections, 30.7 to 62.4 GeV), 4:39824 (COO-2232A-68)
Quantum-chromodynamic predictions for inclusive spin-spin asymmetries at large transverse momentum, 4:39867
Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target, 4:39868
Resonant production of high-transverse-momentum back-to-back gluon jets in pp collisions (27 GeV, cross sections, transverse momentum, angular distribution, proposed experiment), 4:39851 (COO-1545-250)
PROTON-PROTON INTERACTIONS/JET MODEL
Results on correlations and jets in high transverse momentum p-p collisions at the CERN ISR (VS= 62.4 GeV, 3 to 11 GeV/C), 4:39823 (COO-2232A-67)
PROTON-PROTON INTERACTIONS/TRANSVERSE MOMENTUM
Results on correlations and jets in high transverse momentum p-p collisions at the CERN ISR (VS= 62.4 GeV, 3 to 11 GeV/C), 4:39823 (COO-2232A-67)
PROTONS/LIFETIME
Mechanisms of proton stability and decay in unified models (Review, Yang-Mills theory, mechanisms), 4:39863 (LA-UR-79-361)
Some remarks on grand unified models, 4:39835 (UH-511-330-79)
PROTONS/STABILITY
Mechanisms of proton stability and decay in unified models (Review, Yang-Mills theory, mechanisms), 4:39863 (LA-UR-79-361)
Some remarks on grand unified models, 4:39835 (UH-511-330-79)
PROTOTYPE FAST REACTOR (DOUNREAY)
See PFR REACTOR
PSEUDOPARTICLES
See INSTANTONS
PSI-3105 RESONANCES/PARTICLE PRODUCTION
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
PSI-3105 RESONANCES/RADIATIVE DECAY
Production of photons associated with the psi by 217-GeV/cπ^- mesons, 4:39825
PUBLIC BUILDINGS/ENERGY CONSERVATION
An energy conservation retrofit process for existing public and institutional facilities, 4:39011 (PB-284067)
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
PUBLIC BUILDINGS/RETROFITTING
An energy conservation retrofit process for existing public and institutional facilities, 4:39011 (PB-284067)
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
PUBLIC LAW 94-370
See COASTAL ZONE MANAGEMENT ACT
PUBLIC UTILITIES
See also ELECTRIC UTILITIES
GAS UTILITIES
PUBLIC UTILITIES/RATE STRUCTURE
Aspects of public utility regulation. Staff research report, 4:38920 (PB-284145)
PUMPED STORAGE POWER PLANTS/ENVIRONMENTAL IMPACTS
Historical, physical, and chemical limnology of Twin Lakes, Colorado, 4:39632 (PB-283848)
PWR TYPE REACTORS
See also CALHOUN-1 REACTOR
LOFT REACTOR
MILLSTONE-2 REACTOR
OTTO HAHN REACTOR
RANCHO SECO-1 REACTOR
WWER TYPE REACTORS
ZION-1 REACTOR
ZION-2 REACTOR
PWR TYPE REACTORS/ACOUSTIC MONITORING
Experience with diagnostic instrumentation in nuclear power plants, 4:38636
PWR TYPE REACTORS/DISTRICT HEATING
Heat extraction from nuclear power plants, 4:38714 (INIS-mf-4376)
PWR TYPE REACTORS/ECCS
Development of in-vessel reflood instrumentation at ORNL, 4:38794 (CONF-790340-1)
Status report on ECC penetration scaling research, 4:38815 (NUREG/CR-0651)
PWR TYPE REACTORS/FUEL ELEMENTS
Fuel performance improvement program. Quarterly progress report October-December 1978, 4:38624 (COO-4066-9)
PWR TYPE REACTORS/FUEL RODS
FFRS: A computer program for the thermal and mechanical analysis of fuel rods, 4:38627 (RISO-373)
PWR TYPE REACTORS/GASEOUS WASTES
Monitoring of airborne releases from LWR power plants in the Federal Republic of Germany, 4:38777
PWR TYPE REACTORS/LEAK DETECTORS
On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany, 4:38629
PWR TYPE REACTORS/LOOSE PARTS MONITORING
On-line surveillance of LWR primary systems: state of the art and development trends of vibration-, loose parts- and leakage monitoring systems in the Federal Republic of Germany, 4:38629
PWR TYPE REACTORS/LOSS OF COOLANT
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978, 4:38817 (NUREG/CR-0698)
PBF-LOCA single rod tests program experiment specification document, 4:38825 (TFBP-TR-279)
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
Scaling and constitutive relationships in downcomer modeling, 4:38813 (NUREG/CR-0561)
Status report on ECC penetration scaling research, 4:38815 (NUREG/CR-0651)
Technical aspects for PWR safety experiments with single rods and rod bundles in BR2 Mol, 4:38802 (INIS-mf-4426)
Two phase interactions in counter-current flow: studies of the flooding mechanism. Annual report, November 1975-October 1977, 4:38814 (NUREG/CR-0617)
PWR TYPE REACTORS/MELTDOWN
Fission product transport analysis. Quarterly progress report, April 1-June 30, 1978, 4:38817 (NUREG/CR-0698)

Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978, 4:38816 (NUREG/CR-0697)
Steam explosion triggering and efficiency studies, 4:38823 (SAND-78-0261C)
PWR TYPE REACTORS/NOZZLES
Finite element analysis of crack propagation problems for the fracture mechanics evaluation of reactor vessel nozzle junction, 4:38632 (INIS-mf-4506)
PWR TYPE REACTORS/PIPELINES
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
PWR TYPE REACTORS/POWER-COOLING-MISMATCH ACCIDENTS
Behavior of a failed fuel rod during film boiling operation, 4:38797 (CONF-790602-3)
Fuel rod behavior in a nine-rod bundle tested in film boiling, 4:38796 (CONF-790602-2)
PWR TYPE REACTORS/PRESSURE VESSELS
Assessment of the integrity of PWR pressure vessels. A U.K. study group report, 4:38805 (INIS-mf-4506)
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf-4506)
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
PWR TYPE REACTORS/PRIMARY COOLANT CIRCUITS
Fission product transport analysis. Quarterly progress report, January 1-March 31, 1978, 4:38816 (NUREG/CR-0697)
PWR TYPE REACTORS/REACTOR ACCIDENTS
Two-phase flow phenomena in nuclear reactor technology. Quarterly progress report No. 10, September-November 1978, 4:38818 (NUREG/CR-0702)
PWR TYPE REACTORS/REACTOR INSTRUMENTATION
Experience with diagnostic instrumentation in nuclear power plants, 4:38636
PWR TYPE REACTORS/REACTOR NOISE
Neutron noise measurements on pressurized water reactors, 4:38635
PWR TYPE REACTORS/REACTOR PROTECTION SYSTEMS
LLL field test systems division support to the U.S. Nuclear Regulatory Commission. FY 1978 progress report, 4:38827 (UCRL-52708)
PWR TYPE REACTORS/STACK DISPOSAL
Determination of the physico-chemical species of radioiodine in the stack discharge of nuclear power plants, 4:38762 (KFK-EXT-30/78-1)
PWR TYPE REACTORS/STEAM GENERATORS
U-type steam generators for nuclear power plants and their manufacture, 4:38630 (AED-Conf-78-155-006)
PWR TYPE REACTORS/TEST FACILITIES
PBF-LOCA single rod tests program experiment specification document, 4:38825 (TFBP-TR-279)
PYRITES/REMOVAL
Coal desulfurization using microwave energy. Final report, August 1976-October 1977, 4:38045 (PB-285880)
PYROLYTIC OILS/CHEMICAL COMPOSITION
Mechanism of conversion of cellulosic wastes to liquid fuels in alkaline solution, 4:38319
PYROTECHNIC DEVICES/ACTUATORS
Development of a unique pyrotechnic actuator, 4:39518 (SAND-78-1731C)
Pyrotechnic output of TiH/sub x//$CKlO_4$ actuators. IV. Modelling of TiH/sub x//$KClO_4$ actuator pyrotechnic output, 4:39519 (SAND-79-0027)
PYROTECHNIC DEVICES/PERFORMANCE
Pyrotechnic output of TiH/sub x//$CKlO_4$ actuators. IV. Modelling of TiH/sub x//$KClO_4$ actuator pyrotechnic output, 4:39519 (SAND-79-0027)

Q

QUALITY ASSURANCE/STANDARDS
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
QUALITY OF LIFE/ENERGY CONSERVATION
Energy saved is cheaper than energy generated, 4:38905
QUANTUM CHROMODYNAMICS
Quark fragmentation: Some simple tests for quantum chromodynamics, 4:39836
QUANTUM CHROMODYNAMICS/AXIAL-VECTOR CURRENTS
Quantum chromodynamics and the spin-dependent quark-antiquark forces, 4:39838
QUANTUM CHROMODYNAMICS/BAG MODEL
Asymptotic freedom without guilt, 4:39872 (UH-511-329-79)
QUANTUM CHROMODYNAMICS/BOUNDARY CONDITIONS
Asymptotic freedom without guilt, 4:39872 (UH-511-329-79)
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
QUANTUM CHROMODYNAMICS/HADRON-HADRON INTERACTIONS
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
QUANTUM CHROMODYNAMICS/INSTANTONS
Higher-order instanton effects, 4:39876
QUANTUM CHROMODYNAMICS/INTERACTION RANGE
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
QUANTUM CHROMODYNAMICS/PARTICLE PRODUCTION
Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target, 4:39868
QUANTUM CHROMODYNAMICS/PERTURBATION THEORY
Quantum-chromodynamic predictions for large-p/sub T/ hadron production with transversely polarized beam and target, 4:39868
QUANTUM CHROMODYNAMICS/PHOTON-PHOTON INTERACTIONS
Quantum chromodynamics and the dynamics of hadrons (Review, bound state, perturbation theory), 4:39856 (SLAC-PUB-2298)
QUANTUM CHROMODYNAMICS/RADIATIVE CORRECTIONS
Lepton-width suppression of vector-meson decays, 4:39843
QUANTUM CHROMODYNAMICS/RENORMALIZATION
Results on nucleon structure functions in quantum chromodynamics, 4:39873
QUANTUM CHROMODYNAMICS/STRONG INTERACTIONS
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
QUANTUM CHROMODYNAMICS/SU-4 GROUPS
Lattice-gauge-theory spectrum for broken SU(4), 4:39837
QUANTUM MECHANICS/ELECTRONS
Radiation reaction in nonrelativistic quantum theory (Review), 4:39841 (LA-UR-79-357)
QUANTUM OPERATORS
See also HAMILTONIANS
QUANTUM OPERATORS/EIGENVALUES
Gaps in the essential spectra of Schroedinger and Dirac operators, 4:39963 (N-78-30886)
QUARK CONFINEMENT
See BAG MODEL
QUARK MODEL/CHARM PARTICLES
Lecture II. Charmed particle spectroscopy, 4:39859 (FERMILAB-CONF-78/37-THY)
QUARK MODEL/COLOR MODEL
Quasinuclear colored quark model for hadrons (Lectures), 4:39861 (FERMILAB-Conf-78/73-THY)
QUARK MODEL/MESON RESONANCES
Parton recombination model, 4:39852 (DOE/ER/70004-207)
QUARK-ANTIQUARK INTERACTIONS/POTENTIALS
Effective potential for heavy-quark-antiquark bound systems, 4:39839
QUARKS/BOUND STATE
Effective potential for heavy-quark-antiquark bound systems, 4:39839
QUARKS/CONFINEMENT
Asymptotic freedom without guilt, 4:39872 (UH-511-329-79)
QUARKS/FRAGMENTATION
Quark fragmentation: Some simple tests for quantum chromodynamics, 4:39836
QUARKS/PARTICLE INTERACTIONS
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
QUARKS/PARTICLE PROPERTIES
Multilepton final states and the weak interactions of the fifth quark, 4:39850
QUARKS/QUANTUM CHROMODYNAMICS
Quantum chromodynamics and the spin-dependent quark-antiquark forces, 4:39838
QUARKS/THREE-BODY PROBLEM
Quark analysis of multibaryonic systems (Spherical-cavity approximation, kinematics-colar restrictions), 4:39857
QUASI-ELASTIC SCATTERING/ANGULAR MOMENTUM
Angular momentum transfer in deep inelastic scattering. Experimental evidence and a model based upon particle transfer, 4:39933 (INIS-mf-4427)

R

RADIATION ACCIDENTS/EMERGENCY PLAN
Radiological emergency response planning: Handbook for Federal Assistance to State and Local Governments, 4:39662 (NUREG-0093(Rev.1))
RADIATION CHEMISTRY/RESEARCH PROGRAMS
Quarterly report, October 1, 1978-December 31, 1978, 4:39252 (NDRL-1960)
RADIATION DECONTAMINATION
See DECONTAMINATION
RADIATION DETECTORS
See also DOSEMETERS
PROPORTIONAL COUNTERS
RADIATION MONITORS
SCINTILLATION COUNTERS
SECONDARY EMISSION DETECTORS
SPECTROMETERS
WHOLE-BODY COUNTERS
Detectors for in-reactor measurement of energy release (Book; in Russian), 4:39491
RADIATION DETECTORS/DESIGN
Coded aperture imaging with uniformly redundant arrays (Patent), 4:39490
RADIATION DETECTORS/IMAGE PROCESSING
Coded aperture imaging with uniformly redundant arrays (Patent), 4:39490
RADIATION DETECTORS/REVIEWS
Detectors; relation of detectors to proton-anti proton machines, 4:39455 (LBL-7574)
RADIATION DOSEMETERS
See DOSEMETERS
RADIATION DOSIMETRY
See DOSIMETRY
RADIATION HYGIENE
See RADIATION PROTECTION
RADIATION MONITORING
Aims of a measurement program to detect unplanned radioactive discharges from nuclear power stations equipped with light-water reactors, and requirements for the measuring instruments, 4:38828
RADIATION MONITORING/DATA ACQUISITION SYSTEMS
USERDA effluent data collection and reporting program, 4:39583
RADIATION MONITORING/STANDARDIZATION
General principles governing sampling and measurement techniques for monitoring radioactive effluents from nuclear facilities, 4:38288
RADIATION MONITORS
See also NEUTRON MONITORS
Development of a monitoring device for noble gas nuclides in the stack effluent of a BWR nuclear power plant, 4:38735
RADIATION MONITORS/DESIGN
Nuclear incident monitor, 4:39492 (DP-1501)
RADIATION MONITORS/PERFORMANCE
Nuclear incident monitor, 4:39492 (DP-1501)
RADIATION MONITORS/PERFORMANCE TESTING
In-place testing of monitors for airborne reactor effluents, 4:39489
RADIATION PROTECTION/PLANNING
Radiological emergency response planning: Handbook for Federal Assistance to State and Local Governments, 4:39662 (NUREG-0093(Rev.1))
RADIATION SAFETY
See RADIATION PROTECTION
RADIATION SOURCES
(For cosmic sources of radiation see also COSMIC GAMMA SOURCES, COSMIC RADIO SOURCES, and COSMIC X-RAY SOURCES.)
See also GAMMA SOURCES
RADIATION SOURCES/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
RADICALS
See also HYDROXYL RADICALS
RADICALS/ION-MOLECULE COLLISIONS
Reactions of ions with atomic and molecular free radicals. Progress report, May 1, 1978-April 30, 1979 (Summaries of research activities at Univ. of Minnesota), 4:39790 (COO-2640-10)
RADIOACTIVE BIOLOGICAL WASTES
See RADIOACTIVE WASTES
RADIOACTIVE CLOUDS/RADIATION DOSES
Introduction to self-induced rainout, 4:39582 (UCRL-52669)
RADIOACTIVE CLOUDS/WASHOUT
Introduction to self-induced rainout, 4:39582 (UCRL-52669)
RADIOACTIVE EFFLUENTS
See also RADIOACTIVE WASTES
Control of liquid radioactive effluents from nuclear power plants in the Federal Republic of Germany, 4:38764
Radioactive effluent discharges. Intercomparability of data, 4:38771
RADIOACTIVE EFFLUENTS/ENVIRONMENTAL IMPACTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
RADIOACTIVE EFFLUENTS/RADIATION MONITORING
Effluent monitoring: Its purpose and value, 4:38776
Experience in monitoring radioactive liquid effluents from nuclear facilities in the Federal Republic of Germany, 4:38765
General principles of organization and design of monitoring programmes, 4:38774
Monitoring, evaluation and reporting of radioactive liquid and gaseous effluent releases from the CEGB nuclear power stations, 4:38766
Monitoring of radioactive airborne releases in the NRI Rez, 4:38769
Monitoring procedures for effluent releases from nuclear facilities at Trombay, 4:38770
Monitoring of gaseous and liquid effluent releases at French nuclear power stations, 4:38772
Planning for unplanned releases, 4:38761
Problems of monitoring radioactive effluents, 4:38767
RADIOACTIVE EFFLUENTS/RADIATION MONITORS
In-place testing of monitors for airborne reactor effluents, 4:39489
RADIOACTIVE EFFLUENTS/SAFETY STANDARDS
Control of airborne radioactive releases from nuclear power plants in the Federal Republic of Germany, 4:38775
RADIOACTIVE MATERIALS/DOSE RATES
Transportation of radioactive material in Illinois: June 6, 1977-June 6, 1978, 4:38245 (NUREG/CR-0756)
RADIOACTIVE MATERIALS/LAND TRANSPORT
Transportation of radioactive material in Illinois: June 6, 1977-June 6, 1978, 4:38245 (NUREG/CR-0756)
RADIOACTIVE MATERIALS/PACKAGING
Standard format and content of Part 71 applications for approval of packaging of Type B, large quantity, and fissile radioactive material, 4:39278 (REG/G-7.9)
RADIOACTIVE MATERIALS/RAIL TRANSPORT
Dynamic analysis to establish normal shock and vibration of radioactive material shippng packages. Quarterly progress report, July-September 1978, 4:39277 (NUREG/CR-0589)
RADIOACTIVE PARTICULATES
See PARTICLES
RADIOACTIVE WASTE DISPOSAL
See also STACK DISPOSAL
Earth Sciences, 4:38087 (ORNL-5508)
RADIOACTIVE WASTE DISPOSAL/ENVIRONMENTAL IMPACT STATEMENTS
Draft environmental impact statement: management of commercially generated radioactive waste, 4:38285 (DOE/EIS-0046-D(Vol.1))
Draft environmental impact statement: management of commercially generated radioactive waste. Volume 2. Appendices, 4:38286 (DOE/EIS-0046-D(Vol.2))
RADIOACTIVE WASTE DISPOSAL/GEOLOGIC DEPOSITS
Convection and thermal radiation analytical models applicable to a nuclear waste repository room, 4:38274 (UCID-18103)
Status report on research programmes of the Commission of European Communities related to risk evaluation of geological disposal of radioactive waste, 4:38277
Status report for the United Kingdom, 4:38278
United States program for the safety assessment of geologic disposal of commercial radioactive wastes, 4:38276
RADIOACTIVE WASTE DISPOSAL/HEAT TRANSFER
Heat transfer aspects of underground disposal of radioactive waste, 4:38259 (AERE-R-8790)
RADIOACTIVE WASTE DISPOSAL/INFORMATION SYSTEMS
Burial ground technology, 4:39603 (ORNL-5508)
RADIOACTIVE WASTE DISPOSAL/RADIONUCLIDE MIGRATION
Role of mathematical modeling in low-level radioactive waste management, 4:38260 (CONF-790331-2)
RADIOACTIVE WASTE DISPOSAL/RESEARCH PROGRAMS
Burial ground technology, 4:39603 (ORNL-5508)
RADIOACTIVE WASTE DISPOSAL/RISK ASSESSMENT
Estimating probabilities of disposal system failure - A status report, 4:38281
Safety analysis of the proposed Canadian geologic nuclear waste repository, 4:38280
Status report on research programmes of the Commission of European Communities related to risk evaluation of geological disposal of radioactive waste, 4:38277
Status report on radioactive waste risk assessment methodology development supported by the U.S. Environmental Protection Agency, 4:38279

United States program for the safety assessment of geologic disposal of commercial radioactive wastes, 4:38276
RADIOACTIVE WASTE DISPOSAL/SIMULATION
Activities of the Nuclear Energy Agency Computer program library, 4:38282
RADIOACTIVE WASTE DISPOSAL/SPACE FLIGHT
Disposal of radioactive iodine in space, 4:38263 (N-78-31740)
RADIOACTIVE WASTE DISPOSAL/UNDERGROUND DISPOSAL
Estimating probabilities of disposal system failure - A status report, 4:38281
Heat transfer aspects of underground disposal of radioactive waste, 4:38259 (AERE-R-8790)
Shallow land burial - why or why not, 4:38261 (CONF-790331-3)
Status report on radioactive waste risk assessment methodology development supported by the U.S. Environmental Protection Agency, 4:38279
RADIOACTIVE WASTE FACILITIES/DECOMMISSIONING
Information base for waste repository design. Volume 5. Decommissioning of underground facilities, 4:38268 (NUREG/CR-0495(Vol.5))
RADIOACTIVE WASTE FACILITIES/DESIGN
Conceptual design of a nuclear waste vitrification facility, 4:38255 (PNL-2690)
Information base for waste repository design. Volume 7. Executive summary, 4:38270 (NUREG/CR-0495(Vol.7))
Solid waste handling and decontamination facility, 4:38249 (CONF-790331-4)
RADIOACTIVE WASTE FACILITIES/ENVIRONMENTAL IMPACT STATEMENTS
Draft environmental impact statement: Waste Isolation Pilot Plant, 4:38283 (DOE/EIS-0026-D(Vol.1))
Draft environmental impact statement: Waste Isolation Pilot Plant. Volume 2. Appendices, 4:38284 (DOE/EIS-0026-D(Vol.2))
RADIOACTIVE WASTE FACILITIES/EQUIPMENT
Information base for waste repository design. Volume 2. Equipment performance requirements (Mining; handling; ventilation; mine safety and regulation), 4:38265 (NUREG/CR-0495(Vol.2))
RADIOACTIVE WASTE FACILITIES/EXCAVATION
Information base for waste repository design. Volume 6. Excavation technology, 4:38269 (NUREG/CR-0495(Vol.6))
RADIOACTIVE WASTE FACILITIES/HEAT TRANSFER
Convection and thermal radiation analytical models applicable to a nuclear waste repository room, 4:38274 (UCID-18103)
RADIOACTIVE WASTE FACILITIES/MATHEMATICAL MODELS
Limitations to the use of two-dimensional thermal modeling of a nuclear waste repository, 4:38273 (UCID-18101)
RADIOACTIVE WASTE FACILITIES/MECHANICAL STRUCTURES
Information base for waste repository design. Volume .4 Mine structural features, 4:38267 (NUREG/CR-0495(Vol.4))
RADIOACTIVE WASTE FACILITIES/RADIONUCLIDE MIGRATION
Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL-1948)
RADIOACTIVE WASTE FACILITIES/RESEARCH PROGRAMS
Basalt waste isolation program. Quarterly report, October 1-December 31, 1978, 4:38272 (RHO-BWI-79-100-1Q)
Waste-isolation projects, FY 1978, 4:38275 (UCRL-50050-78)
RADIOACTIVE WASTE FACILITIES/SAFETY
Information base for waste repository design. Volume 3. Waste/rock interactions, 4:38266 (NUREG/CR-0495(Vol.3))
RADIOACTIVE WASTE FACILITIES/SEALS
Information base for waste repository design. Volume 1. Borehole and shaft sealing, 4:38264 (NUREG/CR-0495(Vol.1))
RADIOACTIVE WASTE MANAGEMENT
Evaluations of alternatives for management of INEL transuranic waste, 4:38248 (CONF-790602-30)
Review of waste management for a large-scale mixed oxide fuel fabrication facility, 4:38232 (WCAP-9144)
RADIOACTIVE WASTE MANAGEMENT/RECOMMENDATIONS
Need for greater regulatory oversight of commercial low-level radioactive waste, 4:38300 (PB-284841)
RADIOACTIVE WASTE MANAGEMENT/REVIEWS
Waste management state-of-the-art review for mixed-oxide fuel fabrication facilities, 4:38234 (WCAP-9200)
RADIOACTIVE WASTE PROCESSING
Recovery of plutonium from insulation, scrap glass, and sand-slag residues, 4:38257 (RFP-2835)
RADIOACTIVE WASTE PROCESSING/GASEOUS WASTES
Reference facility descriptions for iodine, carbon-14 and krypton radioactive gaseous wastes. Final report, 4:38243 (IDO-1540-T1)
RADIOACTIVE WASTE PROCESSING/HIGH-LEVEL RADIOACTIVE WASTES
Physical modeling of joule heated ceramic glass melters for high level waste immobilization, 4:38256 (PNL-2809)
RADIOACTIVE WASTE PROCESSING/LIQUID WASTES
Adsorption of neptunium and plutonium on metal phosphites, 4:38252 (MLM-2595)
RADIOACTIVE WASTE PROCESSING/OSMOSIS
Study of reverse osmosis applicability to light water reactor radwaste processing, 4:38253 (NUREG/CR-0724)
RADIOACTIVE WASTE PROCESSING/RESEARCH PROGRAMS
Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE-2875)
RADIOACTIVE WASTE PROCESSING/SOLIDIFICATION
Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE-2875)
Processes for immobilization of high-level solid wastes by glass and ceramic matrices, 4:38250 (CONF-790420-9)
Radioactive waste fixation in FUETAP (formed under elevated temperature and pressure) concretes-experimental program and initial results, 4:38254 (ORNL/TM-6573)
RADIOACTIVE WASTE PROCESSING/ULTRAFILTRATION
Study of reverse osmosis applicability to light water reactor radwaste processing, 4:38253 (NUREG/CR-0724)
RADIOACTIVE WASTE PROCESSING/VITRIFICATION
Conceptual design of a nuclear waste vitrification facility, 4:38255 (PNL-2690)
RADIOACTIVE WASTES
See also HIGH-LEVEL RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS
RADIOACTIVE WASTES/LEACHING
Radioactive waste fixation in FUETAP (formed under elevated temperature and pressure) concretes-experimental program and initial results, 4:38254 (ORNL/TM-6573)
Waste-isolation projects, FY 1978, 4:38275 (UCRL-50050-78)
RADIOACTIVE WASTES/WASTE TRANSPORTATION
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL-2457)
RADIOACTIVITY/DATA ACQUISITION SYSTEMS
USERDA effluent data collection and reporting program, 4:39583
RADIOAPPLICATORS
See RADIATION SOURCES
RADIOASSAY/QUALITY ASSURANCE
Environmental radioactivity laboratory intercomparison studies program, 1978-1979. Interim report, 4:39209 (PB-284850)
RADIOAUTOGRAPHY
See AUTORADIOGRAPHY
RADIOCARBON DATING
See CARBON 14
RADIOCHEMICAL ANALYSIS/COUNTING TECHNIQUES
Nuclear chemistry counting facilities: requirements definition, 4:39210 (UCID-18151)
RADIOCHEMISTRY
Radioanalytical chemistry in the USA. Continuing a tradition of excellence, 4:39205
RADIOFREQUENCY SYSTEMS
See RF SYSTEMS
RADIOGRAPHY (AUTO)
See AUTORADIOGRAPHY
RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY
RADIOGRAPHY (INDUSTRIAL)
See INDUSTRIAL RADIOGRAPHY
RADIOISOTOPE HEAT SOURCES/DESIGN
Preliminary design study of an alternate heat source assembly for a Brayton isotope power system. Final report, October 1977-April 1978, 4:38306 (N-78-28608)
RADIOISOTOPE MIGRATION
See RADIONUCLIDE MIGRATION
RADIOISOTOPES/RESEARCH PROGRAMS
Department of Chemistry of the Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, 4:38258 (SGAE-2875)
RADIOMETERS/AIR POLLUTION MONITORS
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)
RADIOMETRIC GAGES/DESIGN
Multi-ray ablation sensor development program. Final report, 2 June 1975-15 December 1976, 4:39496 (AD-A-058366)
RADIOMETRIC GAGES/PERFORMANCE
Development of a device for continuous automatic monitoring of consolidation of fresh concrete. Final report, 4:39497 (PB-285966)

RADIOMETRIC GAGES/PERFORMANCE TESTING
Multi-ray ablation sensor development program. Final report, 2 June 1975-15 December 1976, 4:39496 (AD-A-058366)
RADIONUCLIDE CONCENTRATION
See RADIOACTIVITY
RADIONUCLIDE MIGRATION
(In environment.)
RADIONUCLIDE MIGRATION/MATHEMATICAL MODELS
Role of mathematical modeling in low-level radioactive waste management, 4:38260 (CONF-790331-2)
RADIONUCLIDES
See RADIOISOTOPES
RADIOSURGERY
See RADIOTHERAPY
RADIOTHERAPY/MEDICAL CENTERS
Criteria and standards, for megavoltage radiation therapy installations, 4:39653 (HRP-0018641)
Planning guide for radiologic installations -- fascicle ha, basic concepts, layout considerations, 4:39654 (HRP-0900241)
RADIOTHERAPY/SIDE EFFECTS
Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL-78-65(Pt.2))
RADIOWAVE RADIATION
See also SOLAR RADIOWAVE RADIATION
RADIOWAVE RADIATION/DOSIMETRY
Electromagnetic fields in biological media. I. Dosimetry-a primer on bioelectromagnetics. Final report, 4:39703 (PB-285793)
RADIOWAVE RADIATION/HEALTH HAZARDS
Measurements of electromagnetic fields in the close proximity of CB antennas, 4:39701 (FDA-79-8080)
RADIUM 226/ALPHA SPECTRA
Analysis of thick source alpha particle spectrum from radium and its daughters in bone (^{226}Ra, ^{214}Po), 4:39678 (ANL-78-65(Pt.2))
RADIUM 226/BIOLOGICAL EFFECTS
Lymphoblastogenesis in response to phytohemagglutinin in radium patients: quantitative aspects and reproducibility (^{226}Ra), 4:396 /6 (ANL-78-65(Pt.2))
RADIUM 226/BIOLOGICAL RADIATION EFFECTS
Dose-response relationships for female radium dial workers (^{226}Ra, ^{228}Ra), 4:39673 (ANL-78-65(Pt.2))
RADIUM 226/BODY BURDEN
Field measurements of radium in the human body (^{226}Ra), 4:39681 (ANL-78-65(Pt.2))
RADIUM 226/DATA COMPILATION
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
RADIUM 226/DAUGHTER PRODUCTS
Analysis of thick source alpha particle spectrum from radium and its daughters in bone (^{226}Ra, ^{214}Po), 4:39678 (ANL-78-65(Pt.2))
RADIUM 226/DELAYED RADIATION EFFECTS
^{226}Ra, ^{210}Pb, ^{210}Po, and calcium in the eyes of long-term radium cases, 4:39680 (ANL-78-65(Pt.2))
RADIUM 226/INGESTION
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL-78-65(Pt.2))
RADIUM 226/RADIOCHEMICAL ANALYSIS
Radiochemical determination of ^{226}Ra in bone: a preliminary analysis of results, 4:39679 (ANL-78-65(Pt.2))
RADIUM 226/RADIOECOLOGICAL CONCENTRATION
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
RADIUM 228/BIOLOGICAL RADIATION EFFECTS
Dose-response relationships for female radium dial workers (^{226}Ra, ^{228}Ra), 4:39673 (ANL-78-65(Pt.2))
RADIUM 228/INGESTION
Normal dietary levels of ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po for man, 4:39691 (ANL-78-65(Pt.2))
RADIUM ISOTOPES/BIOLOGICAL RADIATION EFFECTS
Radiological and Environmental Research Division annual report, July 1977-June 1978, 4:39670 (ANL-78-65(Pt.2))
Recent cases of radium-induced malignancy, 4:39671 (ANL-78-65(Pt.2))
RADIUM ISOTOPES/DELAYED RADIATION EFFECTS
Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL-78-65(Pt.2))
RADIUM ISOTOPES/HEALTH HAZARDS
Survival times of women radium dial workers first exposed before 1930, 4:39674 (ANL-78-65(Pt.2))
RADON/DELAYED RADIATION EFFECTS
Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL-78-65(Pt.2))
RADON/EXHALATION
Postprandial changes in the exhalation rate of radon produced in vivo, 4:39578 (ANL-78-65(Pt.2))
Postprandial changes in the exhalation of radon from the environment, 4:39579 (ANL-78-65(Pt.2))
RADON/LABORATORY EQUIPMENT
Design, construction, and operation of a new radon transfer system, 4:39256 (ANL-78-65(Pt.2))
RADON/MATERIALS HANDLING
Design, construction, and operation of a new radon transfer system, 4:39256 (ANL-78-65(Pt.2))
RADON/RADIOECOLOGICAL CONCENTRATION
Postprandial changes in the exhalation of radon from the environment, 4:39579 (ANL-78-65(Pt.2))
RAIL TRANSPORT/ENERGY CONSUMPTION
The energy cost of road and rail transport in Tasmania, 4:39025 (PB-283952)
RAIL TRANSPORT/IMPACT SHOCK
Dynamic analysis to establish normal shock and vibration of radioactive material shippng packages. Quarterly progress report, July-September 1978, 4:39277 (NUREG/CR-0589)
RAILWAYS/COMPARATIVE EVALUATIONS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
RAIN WATER/PH VALUE
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
RAIN WATER/POLLUTION
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
RANCHO SECO-1 REACTOR/RADIOACTIVE EFFLUENTS
Rancho Seco building wake effects on atmospheric diffusion. Technical memo, 4:38763 (PB-285165)
RANCHO SECO-2 REACTOR/RADIOACTIVE EFFLUENTS
Rancho Seco building wake effects on atmospheric diffusion. Technical memo, 4:38763 (PB-285165)
RANGELANDS/FORAGE
Diets of mule deer within steppe vegetation of south central Washington (Dietary preferences at three locations on the Hanford Reservation), 4:39606 (BNWL-SA-6532)
RANKINE CYCLE ENGINES/COMBUSTORS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
RARE EARTH ALLOYS/CRYSTAL STRUCTURE
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH ALLOYS/LATTICE PARAMETERS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH ALLOYS/MAGNETIC PROPERTIES
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH ALLOYS/PHASE DIAGRAMS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH COMPOUNDS/CRYSTAL STRUCTURE
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH COMPOUNDS/DISSOCIATION ENERGY
Model calculations of the thermochemical properties of gaseous metal halides. Interim report, 4:39219 (AD-A-059503)
RARE EARTH COMPOUNDS/LATTICE PARAMETERS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH COMPOUNDS/MAGNETIC PROPERTIES
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH COMPOUNDS/PHASE DIAGRAMS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTH COMPOUNDS/THERMODYNAMIC PROPERTIES
Model calculations of the thermochemical properties of gaseous metal halides. Interim report, 4:39219 (AD-A-059503)
Stability of the lanthanide hydrides, 4:39221 (LA-7602-MS)
RARE EARTHS/CRYSTAL STRUCTURE
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTHS/LATTICE PARAMETERS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTHS/MAGNETIC PROPERTIES
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RARE EARTHS/PHASE DIAGRAMS
Magnetic structures and inelastic neutron scattering: metals, alloys, and compounds, 4:39160
RATE STRUCTURE/PUBLIC OPINION
Demand management demonstration project. Stage 1: development of residential load characteristics and Stage 4: demonstration of residential incremental cost pricing

implemented by time-of-day metering. Final report, January 1979, 4:38930 (HCP/B8072-01)
RATE STRUCTURE/SOCIO-ECONOMIC FACTORS
Los Angeles senior citizen lifeline electricity rates, 4:38932 (RAND/R-2278-DWP/NSF)
RATS/SURVIVAL TIME
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
RAYLEIGH WAVES/WAVE PROPAGATION
Relationship between near-field and teleseismic observations of seismic source parameters. Final report 1 Apr 73-30 Sep 77, 4:39526 (AD-A-059529)
REACTION INTERMEDIATES/ELECTRONIC STRUCTURE
Chemical information in Auger spectroscopy, 4:39241 (LBL-8975)
REACTOR ACCIDENTS
See also BLOWDOWN
FUEL ELEMENT FAILURE
LOSS OF COOLANT
MELTDOWN
POWER-COOLING-MISMATCH ACCIDENTS
REACTOR CORE DISRUPTION
REACTOR ACCIDENTS/MATHEMATICAL MODELS
Consequence model of the German reactor safety study, 4:38824 (SAND-78-2074C)
REACTOR ACCIDENTS/TWO-PHASE FLOW
Two-phase flow phenomena in nuclear reactor technology. Quarterly progress report No. 10, September-November 1978, 4:38818 (NUREG/CR-0702)
REACTOR COMPONENTS
See also BREEDING BLANKETS
FUEL ELEMENTS
REACTOR COOLING SYSTEMS
REACTOR CORES
REACTOR COMPONENTS/CLEANING
Sodium technology progress report, October-December 1978 (LMFBR), 4:38673 (HEDL-TME-78-93)
REACTOR COMPONENTS/MECHANICAL VIBRATIONS
Diagnosis of subharmonic vibrations in rotating machinery, 4:38729
REACTOR COMPONENTS/OXIDATION
Oxide thickness monitor, 4:39506 (N-78-28429)
REACTOR COMPONENTS/QUALITY ASSURANCE
Contribution from U.S. system suppliers to the power generating industry, 4:38732 (AED-Conf-78-048-003)
REACTOR COMPONENTS/STRESS ANALYSIS
Application of computer methods to creep analysis, 4:38748
Approximate procedures in high temperature design, 4:38739
Creep analysis in structures. Finite element creep buckling analysis of shallow spherical shells, 4:38745 (UTNL-R-0046)
Material data for high temperature design, 4:39142
Simplified methods for piping analysis in the creep regime, 4:38749
Structures subjected to severe loading conditions, 4:38734
REACTOR COMPONENTS/WELDED JOINTS
Baseline inspection of three transition joint life test articles (LMFBR), 4:38666 (GEFR-00414)
REACTOR CONTROL SYSTEMS
(The processes and operations ensuring the control and safe running of a nuclear reactor.)
Nuclear power plant operational diagnostics and control, 4:38756
Spatial power control in large CANDU reactors: the whys and wherefores, 4:38751 (AECL-6212)
REACTOR CONTROL SYSTEMS/AUTOMATION
New and already approved - the power plant control system PROCONTROL K by Brown-Boveri, 4:38752 (AED-Conf-78-155-027)
REACTOR CONTROL SYSTEMS/DATA PROCESSING
Transmission and distribution of information in power plants, 4:38753 (AED-Conf-78-155-033)
REACTOR CONTROL THEORY
See REACTOR KINETICS
REACTOR COOLING SYSTEMS
See also PRIMARY COOLANT CIRCUITS
REACTOR COOLING SYSTEMS/COOLANT CLEANUP SYSTEMS
Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
REACTOR COOLING SYSTEMS/DECONTAMINATION
Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
REACTOR COOLING SYSTEMS/FLOWMETERS
Estimation and reduction of errors in flow measurements which use cross-correlation techniques, 4:38741
REACTOR COOLING SYSTEMS/RESTRAINTS
Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping, 4:38826 (UCB/EERC-79/08)
REACTOR COOLING SYSTEMS/SEISMIC EFFECTS
Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 2. Development of analyses for reactor system piping, 4:38826 (UCB/EERC-79/08)
REACTOR COOLING SYSTEMS/WATER CHEMISTRY
Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
REACTOR CORE DISRUPTION/AEROSOLS
1978 annual report: aerosol characterization from a simulated HCDA, 4:38820 (NUREG/CR-0740)
REACTOR CORE DISRUPTION/DYNAMIC LOADS
Analysis of nonlinear fluid structure interaction transient in fast reactors, 4:38790 (ANL-78-103)
REACTOR CORE DISRUPTION/HYDRODYNAMICS
Analysis of nonlinear fluid structure interaction transient in fast reactors, 4:38790 (ANL-78-103)
REACTOR CORES/HEAT TRANSFER
Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores, 4:38641 (LA-7709-T)
REACTOR CORES/HYDRAULICS
Thermal-hydraulic analysis techniques for axisymmetric pebble bed nuclear reactor cores, 4:38641 (LA-7709-T)
REACTOR CORES/MECHANICAL VIBRATIONS
One-fifth scale full-array test report. Final report, 4:38799 (GA-A-14546)
REACTOR CORES/SEISMIC EFFECTS
One-fifth scale full-array test report. Final report, 4:38799 (GA-A-14546)
REACTOR CORES/SIMULATION
One-fifth scale full-array test report. Final report, 4:38799 (GA-A-14546)
REACTOR FUEL ELEMENTS
See FUEL ELEMENTS
REACTOR FUELS
See NUCLEAR FUELS
REACTOR INSTRUMENTATION
See also LOOSE PARTS MONITORING
REACTOR INSTRUMENTATION/RELIABILITY
Neutronic control instrumentation of protection systems, 4:38733 (CEA-CONF-3997)
REACTOR INTERNALS/HEAT TRANSFER
COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis (LMFBR), 4:38685 (NUREG/CR-0785)
REACTOR INTERNALS/HYDRAULICS
COMMIX-1: a three-dimensional transient single-phase component computer program for thermal-hydraulic analysis (LMFBR), 4:38685 (NUREG/CR-0785)
REACTOR KINETICS/NEUTRON TRANSPORT THEORY
Transport and reactor theory. Progress report, October 1-December 31, 1978, 4:38724 (LA-7704-PR)
REACTOR KINETICS/REVIEWS
Physical fundamentals of reactor engineering, 4:38720 (AED-Conf-78-023-002)
REACTOR LATTICES/REACTIVITY
Reactivity prediction of uniform PuO_2-UO_2-fueled lattices and $Pu(NO_3)_4$ solutions in light water, 4:38727
REACTOR LICENSING/SPECIFICATIONS
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 3.9.2, 4:38702 (NTISUB/B/201-003-R5)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 4.2, 4:38703 (NTISUB/B/201-004-R3)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 6.2.6, 4:38704 (NTISUB/B/201-006-R8)
Standard Review Plan for the review of safety analysis reports for nuclear power plants, Revision No. 1 to Section 9.4.1, 4:38705 (NTISUB/B/201-009-R9)
REACTOR MATERIALS
(See also specific materials.)
See also NUCLEAR FUELS
Design rules for high temperature plant - the implications of recent research in relation to current practice, 4:38681
REACTOR MATERIALS/CREEP
Materials data for severe variable loading, 4:38697
REACTOR MATERIALS/PHYSICAL RADIATION EFFECTS
Radiation-induced defect production in structural materials at reactor temperatures, 4:39166 (EUR-5667(Pt.2))
REACTOR NOISE
Decomposition of noise signals composed of many similar components, 4:38637
Reactivity effects and space-domain noise caused by randomly dispersed materials in a reactor core, 4:38728

REACTOR PROTECTION SYSTEMS/EVALUATION
LLL field test systems division support to the U.S. Nuclear Regulatory Commission. FY 1978 progress report, 4:38827 (UCRL-52708)
REACTOR PROTECTION SYSTEMS/REACTOR INSTRUMENTATION
Neutronic control instrumentation of protection systems, 4:38733 (CEA-CONF-3997)
REACTOR SAFETY
(Theoretical and experimental investigations of the behavior of reactor types and designs under various real or hypothetical accidents.)
REACTOR SAFETY/RESEARCH PROGRAMS
Annual technical progress report: reactor safety, Government fiscal year 1978, 4:38798 (ESG-DOE-13254)
List of reports on reactor safety research by BMFT, USNRC, EPRI and JSTA. Period under review: 1st January until 31st March 1978. Progress report, 4:38801 (GRS-F-54)
REACTOR SITES/BIBLIOGRAPHIES
Power plant siting (A bibliography with abstracts). Report for 1964-September 1978, 4:38760 (NTIS/PS-78/1007)
REACTOR TECHNOLOGY/RESEARCH PROGRAMS
Nuclear power reactor technology. Work, experience and services offerede by Risoe National Laboratory, 4:38726 (RISO-M-2132)
REACTORS
See also BREEDER REACTORS
HEAVY WATER MODERATED REACTORS
POWER REACTORS
WATER COOLED REACTORS
REACTORS/IN CORE INSTRUMENTS
Detectors for in-reactor measurement of energy release (Book; in Russian), 4:39491
RECYCLE (FUEL)
See FUEL CYCLE
RECYCLING/ENVIRONMENTAL EFFECTS
Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final report, 4:38164 (PB-283719)
RECYCLING/TECHNOLOGY ASSESSMENT
Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final report, 4:38164 (PB-283719)
RECYCLING (FUEL)
See REPROCESSING
REFLECTIVITY/MEASURING METHODS
Apparatus for simultaneous measurement of mass change, optical transmittance, and reflectance of thin films, 4:39192
REFRACTORIES/BRAZING
Selected advances in materials research, 4:39106 (CONF-790343-1)
REFRIGERATING MACHINERY/FUEL CONSUMPTION
Air leakage in refrigerated vans. Final report, 4:39020 (COO-4338-4)
REFRIGERATING MACHINERY/PISTONS
Adjustable expandable cryogenic piston and ring (Patent), 4:39274
REFRIGERATING MACHINERY/RINGS
Adjustable expandable cryogenic piston and ring (Patent), 4:39274
REFRIGERATING MACHINERY/THERMODYNAMIC CYCLES
Comparison of conjugate cyles of power and refrigerating installations, 4:39267
REFUSE
See SOLID WASTES
REGION V
See GREAT LAKES REGION
REGION VII
See MIDWEST REGION
REGION X
See PACIFIC NORTHWEST REGION
REINDEER
See DEER
REINFORCED MATERIALS/TECHNOLOGY ASSESSMENT
Technology assessment of advanced composite materials. Phase I. Final report, 4:39171 (PB-283416)
REMOTE HANDLING EQUIPMENT/PERFORMANCE
Monitor 1979, 4:39451 (LA-UR-79-689)
RENE 80/ALUMINIUM OXIDES
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
RENE 80/FATIGUE
Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80, 4:39135
RENE 80/MECHANICAL PROPERTIES
Strainrange partitioning analysis of low cycle fatigue of coated and uncoated Rene' 80, 4:39135
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and IN 100, 4:39136
RENEWABLE ENERGY SOURCES
See also BIOMASS
GEOTHERMAL ENERGY
HYDROELECTRIC POWER
SOLAR ENERGY
TIDAL POWER
WIND POWER
RENEWABLE ENERGY SOURCES/ALLOCATIONS
Fair allocations of a renewable resource. Research report, 4:38908 (AD-A-057953)
RENEWABLE ENERGY SOURCES/MANAGEMENT
Resources, residuals and irreversible land conversions: prototype management instruments, 4:38877 (PB-283968)
REPROCESSING/ORGANIC COMPOUNDS
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM-6672)
REPROCESSING/PHOTOCHEMICAL REACTIONS
Photochemistry of the actinides, 4:39253 (CONF-790415-21)
REPRODUCTION/PATHOLOGICAL CHANGES
Tests of biological integrity in dogs exposed to an electromagnetic pulse environment, 4:39700 (AD-A-059749)
RESEARCH PROGRAMS
See also COORDINATED RESEARCH PROGRAMS
RESEARCH PROGRAMS/BIBLIOGRAPHIES
Annotated bibliography of Interagency Energy/Environment R and D Program publications (Publications sponsored by USEPA), 4:39527 (PB-284399)
RESEARCH PROGRAMS/FINANCING
Federal R and D funding: modest gains in 1979, 4:38510
RESERVOIR PRESSURE/MEASURING METHODS
Determination of stratal pressure with the aid of fluid additions, 4:38151
RESERVOIR ROCK/HETEROGENEOUS EFFECTS
Analysis of five-spot tracer tests to determine reservoir layering, 4:38133 (SAN-1265-8)
RESIDENTIAL BUILDINGS
See also APARTMENT BUILDINGS
HOUSES
RESIDENTIAL BUILDINGS/AIR CONDITIONING
Residential electric heating and cooling: total cost of service, 4:39003 (CONF-7809138-1)
RESIDENTIAL BUILDINGS/ENERGY CONSERVATION
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
Energy conservation technology education program. Final report, 4:38902 (HCP/M-2165)
National energy plan: energy conservation in appliances. Final report, 4:39004 (HIT-691)
RESIDENTIAL BUILDINGS/ENERGY SUPPLIES
Energy in new housing: economic and technical aspects of alternative sources of supply, 4:38940
RESIDENTIAL BUILDINGS/GEOTHERMAL SPACE HEATING
Recent developments in geothermal multipurpose utiliztaion in Jozankei Hot Springs in Sapporo City, 4:38552
RESIDENTIAL BUILDINGS/HEATING SYSTEMS
Fireplace systems (Patent), 4:39006
RESIDENTIAL BUILDINGS/RETROFITTING
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
RESIDENTIAL BUILDINGS/SOLAR SPACE HEATING
Solar assisted heat pump study for heating of military facilities. Final report, July 1976-November 1977, 4:38415 (AD-A-058626)
RESIDENTIAL BUILDINGS/SPACE HEATING
Feasibility of heat pumps for residential space heating in New Zealand, 4:39007
Residential electric heating and cooling: total cost of service, 4:39003 (CONF-7809138-1)
RESIDENTIAL SECTOR/ENERGY CONSUMPTION
An annotated compilation of the sources of information related to the usage of electricity in non-industrial applications. Final report, 4:38931 (PB-285260)
RESIDUAL INTERACTIONS/PAIRING INTERACTIONS
Coherent residual interactions: pairing plus particle-hole (Quasi-particles, schematic Hamiltonian), 4:39929
RESIDUAL PETROLEUM/EVALUATION
Study of the potential for future work on methods of determining residual oil. Final report, 4:38139 (BETC-0007-3)
RESIDUAL PETROLEUM/INFORMATION NEEDS
Study of the potential for future work on methods of determining residual oil. Final report, 4:38139 (BETC-0007-3)
RESIDUES
See also ASHES
RESIDUES/COKING
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)

RESIDUES/GASIFICATION
EDS coal liquefaction process development: Phase IV. Summary of EDS predevelopment (1966-1975), interim report, 4:38077 (FE-2893-16)
Solvent refined coal (SRC) process. Research and development report No. 53. Interim report No. 23, 1976-1977. Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 11. Processing of solvent refined coal minerals, 4:38073 (FE-0496-T14)
RESIDUES (RADIOACTIVE)
See RADIOACTIVE WASTES
RESISTIVITY (ELECTRIC)
See ELECTRIC CONDUCTIVITY
RESOURCE ASSESSMENT
The nation's water resources, the Second National Water Assessment, summary report, 4:38880 (PB-285746)
The nation's water resources: the Second National Water Assessment. Part I. Introduction, 4:38881 (PB-285747)
The nation's water resources: the Second National Water Assessment. Part II. Water management problem profiles, 4:38882 (PB-285748)
The nation's water resources: the Second National Water Assessment. Part III. Functional water uses, 4:38883 (PB-285749)
The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations, 4:38884 (PB-285750)
The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries, 4:38885 (PB-285751)
The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data, 4:38886 (PB-285815)
RESOURCE CONSERVATION
Brief review of the Resource Conservation and Recovery Act (RCRA) 1976, 4:38875 (CONF-790331-1)
RESOURCE RECOVERY ACTS
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
RESOURCE RECOVERY ACTS/REVIEWS
Brief review of the Resource Conservation and Recovery Act (RCRA) 1976, 4:38875 (CONF-790331-1)
RESOURCE RECOVERY FACILITIES/TECHNOLOGY ASSESSMENT
Engineering and economic analysis of waste to energy systems. Final report, April 1975-June 1977, 4:39047 (PB-285797)
RESOURCES
See also GEOTHERMAL RESOURCES
MINERAL RESOURCES
RESOURCES/ENERGY SOURCE DEVELOPMENT
Environmental Resources Section, 4:40051 (ORNL-5508)
RESOURCES/ENVIRONMENT
Environmental Resources Section, 4:40051 (ORNL-5508)
RESPIRATORY SYSTEM DISEASES/MONITORING
Application of a time-space clustering methodology to the assessment of acute environmental effects on respiratory illnesses, 4:39696 (COO-2874-46)
RETINA/PATHOLOGICAL CHANGES
Mechanisms of retinal damage from chronic laser radiation. Thresholds and mechanisms. Annual report, No. 4. 1 November 1976-31 October 1977, 4:39699 (AD-A-058449)
RF SYSTEMS/COMPARATIVE EVALUATIONS
Advances in high-power rf amplifiers, 4:39452 (LA-UR-79-705)
RHENIUM ALLOYS/CHEMICAL COMPOSITION
Selected advances in materials research, 4:39106 (CONF-790343-1)
RHODAMINES/SELF-ABSORPTION
Self-absorption of molecular fluorescence, the design of equipment for measurement of fluorescence decay, and the decay times of some laser dyes), 4:39297
RHODIUM/CATALYTIC EFFECTS
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
RICHLAND FFTF REACTOR
See FFTF REACTOR
RICHLAND NPR REACTOR
See N-REACTOR
RIEMANN WAVES
See SHOCK WAVES
RINGOTRON
See ELECTRON-RING ACCELERATORS
RINGS/DESIGN
Adjustable expandable cryogenic piston and ring (Patent), 4:39274
RINGS/LUBRICATION
Piston ring scuffing, 4:39078
RINGS/WEAR
Piston ring scuffing, 4:39078
RINGS (STORAGE)
See STORAGE RINGS
RISER CRACKING
See COAL LIQUEFACTION
RISK ASSESSMENT/QUALITY ASSURANCE
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
RISOE NATIONAL LABORATORY/REACTOR TECHNOLOGY
Nuclear power reactor technology. Work, experience and services offerede by Risoe National Laboratory, 4:38726 (RISO-M-2132)
RIVERS
See also STREAMS
RIVERS/THERMAL POLLUTION
Thermal loading of river systems, 4:39630
RIVETS
See FASTENERS
ROADS/AIR POLLUTION
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
ROCKET ENGINES/IMPLOSIONS
Structural response of VRO and FKM propellants during a rocket motor implosion, 4:39261 (UCID-18160)
ROCKETS/EXHAUST GASES
The kinetics and spectroscopy of aircraft and rocket plume constituents. Interim report 1 jun 77-31 may 78, 4:39538 (AD-A-059809)
ROCKS
See also METAMORPHIC ROCKS
PHOSPHATE ROCKS
RESERVOIR ROCK
ROCKS/PERMEABILITY
Waste-isolation projects, FY 1978 (Argillite), 4:38275 (UCRL-50050-78)
ROCKS/THERMAL CONDUCTIVITY
Pre-calculation of the temperature of air currents in a tunnel designed to excavate in the rock mass at high temperature, 4:38523
ROCKS/THERMODYNAMIC PROPERTIES
Thermal properties of rocks and heat extraction from hot dry rocks. I, 4:38553
ROOF BOLTS/DESIGN
Roof bolting hazard analysis study. Final report, 1 July 1976-30 June 1977, 4:38099 (PB-284016)
ROOF BOLTS/SAFETY
Roof bolting hazard analysis study. Final report, 1 July 1976-30 June 1977, 4:38099 (PB-284016)
ROOFS/SUPPORTS
Mine roof support method and apparatus (Patent), 4:38106
ROTARY ENGINES/EXHAUST GASES
Performance characteristics of automotive engines in the United States. First series - Report No. 14. 1975 Mazda rotary 70 CID (1.1 liters), 4v. Interim report, July 1977, 4:38983 (PB-286074)
ROTARY ENGINES/FUEL ECONOMY
Performance characteristics of automotive engines in the United States. First series - Report No. 14. 1975 Mazda rotary 70 CID (1.1 liters), 4v. Interim report, July 1977, 4:38983 (PB-286074)
ROTARY ENGINES/PERFORMANCE TESTING
Performance characteristics of automotive engines in the United States. First series - Report No. 14. 1975 Mazda rotary 70 CID (1.1 liters), 4v. Interim report, July 1977, 4:38983 (PB-286074)
ROTORS
See also DARRIEUS ROTORS
ROTORS/FABRICATION
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
ROTORS/PERFORMANCE TESTING
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
ROTORS/RESEARCH PROGRAMS
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
ROTORS/STABILITY
Wave resistance in a rotating liquid layer, 4:39327 (UCRL-82436)
ROTORS/WAVE FORCES
Wave resistance in a rotating liquid layer, 4:39327 (UCRL-82436)
RUBIDIUM/ION COLLISIONS
K-shell ionization of elements $_{29}$Cu to $_{37}$Rb for 0.4-3.8-MeV/amu $^{10}_{5}$B-ion bombardment, 4:39779
RUBY LASERS/FREQUENCY CONVERTERS
RDA ruby laser frequency doubler system. Quarterly progress report no. 3, 24 oct 73-23 jan 74, 4:39281 (AD-923260)

RUBY LASERS/MODE LOCKING
Generation of high power ultrashort pulses in a low-temperature ruby laser with a small active volume, 4:39313
RUTHENIUM/CATALYTIC EFFECTS
Catalytic synthesis of hydrocarbons, 4:38316 (LBL-8975)
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
RUTHENIUM ALLOYS/CATALYTIC EFFECTS
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
RUTHENIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
RUTHENIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
RUTHENIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)

S

SAFEGUARDS
See also PHYSICAL PROTECTION DEVICES
Applying new safeguards technology to existing nuclear facilities, 4:38289 (CONF-790430-2)
SAFEGUARDS/INFORMATION SYSTEMS
Integrated safeguards information system (ISIS). Executive summary. Technical report, 4:38293 (PB-286869)
SAFETY
See also REACTOR SAFETY
SAFETY/QUALITY ASSURANCE
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
SAFETY (NUCLEAR)
See RADIATION PROTECTION
SALT DEPOSITS/CREEP
Interim summary of Sandia creep experiments on rock salt from the WIPP study area, southeastern New Mexico, 4:39727 (SAND-79-0115)
SALTS/ECOLOGICAL CONCENTRATION
Tropospheric aerosols, 4:39535
SALTS/RADIOMETRIC ANALYSIS
Determining the water-insoluble residue in potassium salts by gamma surveying, 4:38204
SAMARIUM 148 TARGET/OXYGEN 16 REACTIONS
Effect of nuclear deformation on heavy-ion fusion (Cross sections, excitation, lifetime potential), 4:39911 (INIS-mf-4427)
SAMARIUM 150 TARGET/OXYGEN 16 REACTIONS
Effect of nuclear deformation on heavy-ion fusion (Cross sections, excitation, lifetime potential), 4:39911 (INIS-mf-4427)
SAMARIUM 152 TARGET/OXYGEN 16 REACTIONS
Effect of nuclear deformation on heavy-ion fusion (Cross sections, excitation, lifetime potential), 4:39911 (INIS-mf-4427)
SAMARIUM 154 TARGET/OXYGEN 16 REACTIONS
Effect of nuclear deformation on heavy-ion fusion (Cross sections, excitation, lifetime potential), 4:39911 (INIS-mf-4427)
SAMPLE PREPARATION/EQUIPMENT
Apparatus for sectioning diffusion specimens in liquid nitrogen, 4:39512
SAMPLERS/DATA ACQUISITION SYSTEMS
In Situ Environmental Sampler (IES): descriptive analysis and operating procedures, 4:39507 (SAND-78-1342)
SAMPLERS/ELECTRONIC CIRCUITS
In Situ Environmental Sampler (IES): descriptive analysis and operating procedures, 4:39507 (SAND-78-1342)
SAND/GAMMA LOGGING
Determining the composition of sand-clay soils from polarization potentials and gamma logging, 4:39515
SAND/SP LOGGING
Determining the composition of sand-clay soils from polarization potentials and gamma logging, 4:39515
SAND PRESSURE
See RESERVOIR PRESSURE
SANDIA LABORATORIES/EDUCATION
Sandia Laboratories education and training programs. Third annual report, 1977-1978, 4:40029 (SAND-78-2242)
SANDIA LABORATORIES/HEALTH HAZARDS
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
SANDIA LABORATORIES/SAFETY
Proposed standard for ES and H assurance programs, 4:39704 (SAND-79-0240)
SANITARY LANDFILLS/LAND POLLUTION ABATEMENT
Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB-285072)
SANITARY LANDFILLS/WATER POLLUTION ABATEMENT
Compilation and evaluation of leaching test methods. Final report, 4:39597 (PB-285072)
SARCOMAS
See also OSTEOSARCOMAS
SARCOMAS/RADIOINDUCTION
Dose-response relationships for female radium dial workers (^{226}Ra, ^{228}Ra), 4:39673 (ANL-78-65(Pt.2))
Recent cases of radium-induced malignancy, 4:39671 (ANL-78-65(Pt.2))
SATELLITES
See also MOON
SATELLITES/ATTITUDE CONTROL
Plan for flight evaluation of attitude stabilization and flexible solar array dynamics for the Communications Technology Satellite, 4:38396
SATELLITES/BIBLIOGRAPHIES
A bibliography of planetary geology principal investigators and their associates, 1976-1978, 4:39756 (N-78-28027)
SATELLITES/ELECTRIC CABLES
Radiation effects in satellite cables. Final report 1 Apr 77-31 Mar 78, 4:39502 (AD-A-059446)
SATELLITES/MEETINGS
Space and energy (XXVI international astronautical), 4:38354
SATELLITES/REMOTE SENSING
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)
SAUDI ARABIA/DESALINATION REACTORS
Desalination projects in the Kingdom of Saudi Arabia, 4:38707 (IAEA-206)
SAUDI ARABIA/DUAL-PURPOSE POWER PLANTS
Desalination projects in the Kingdom of Saudi Arabia, 4:38707 (IAEA-206)
SAUDI ARABIA/ENERGY POLICY
Energy situation in the Arab world, 4:38923
SAVANNAH RIVER PLANT/METAMORPHIC ROCKS
Determination of the location and connectivity of fractures in metamorphic rock with in-hole tracers, 4:39707 (DP-MS-79-11)
SCHNELLER NATRIUMGEKUEHLTER REAKTOR
See SNR-1 REACTOR
SCHOOL BUILDINGS/AIR QUALITY
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
SCHOOL BUILDINGS/ENERGY CONSERVATION
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
SCHOOL BUILDINGS/GEOTHERMAL SPACE HEATING
Geothermal application feasibility study for the New Mexico State University campus. Technical report, 4:38550 (NMEI-13)
SCHOOL BUILDINGS/RETROFITTING
Assessment of energy conservation measures applied to oil heated buildings. (Task 700), 4:39009 (HIT-687)
SCHOOL BUILDINGS/VENTILATION
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
SCHROEDINGER EQUATION/NONLINEAR PROBLEMS
Damped double solitons in the nonlinear Schroedinger equation, 4:39998
SCHROEDINGER EQUATION/QUANTUM OPERATORS
Gaps in the essential spectra of Schroedinger and Dirac operators, 4:39963 (N-78-30886)
SCHWINGER SOURCE THEORY/BAG MODEL
Quark confinement in unusual environments, 4:39875
SCINTILLATION COUNTERS
Experience of measuring radioactive iodine by the cumulative method in gaseous discharges from nuclear power stations, 4:38737
SCINTILLATION COUNTERS/CHERENKOV RADIATION
Optical Cerenkov radiation from microscopic $BaSO_4$ grains, 4:39504
SCREWS
See FASTENERS
SCRUBBERS/DESIGN
Control of nitrogen oxides from stationary source effluents (Patent), 4:39356
SCRUBBERS/OPERATION
Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April-December 1977, 4:38602 (PB-284045)

SCRUBBERS/PERFORMANCE
Characterization of carbide lime to identify sulfite oxidation inhibitors. Final report Sep 77-Jul 78, 4:38606 (PB-286646)
SCRUBBERS/PERFORMANCE TESTING
CEA variable-throat venturi scrubber evaluation. Final report, May 1977-December 1977 (CEA = Combustion Equipment Associates), 4:38604 (PB-285723)
Geothermal Loop Experimental Facility. Quarterly report, January-March 1978, 4:38543 (SAN-1137-10)
SCRUBBERS/SLUDGES
Lime/limestone scrubbing sludge characterization - Shawnee Test Facility. Final report March 1975-June 1976, 4:39352 (PB-284111)
SEACOAST
See SHORES
SEALING MATERIALS/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SEALING MATERIALS/CHEMICAL COMPOSITION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
SEALING MATERIALS/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SEALING MATERIALS/PERFORMANCE TESTING
Development of alternate silicone potting compounds. Vol.4. Development of a substitute for Dow Corning's aerospace sealant DC 93-120 resin cured with DC 93-122 curing agent, 4:39182 (UCRL-52434(Vol.4))
SEALING MATERIALS/THERMAL DEGRADATION
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
SEAWATER/DISTILLATION
Report of the Geothermal Utilization Committee, 4:38549
SEAWEEDS/ANAEROBIC DIGESTION
Review of the energy from Marine Biomass Program, 4:38320
SEAWEEDS/CULTIVATION
Review of the energy from Marine Biomass Program, 4:38320
SEBACEOUS GLANDS
See SKIN
SECONDARY EMISSION DETECTORS/FABRICATION
Tests of a new secondary emission chamber at the AGS (Extracted beam intensity), 4:39435 (BNL-25795)
SECONDARY EMISSION DETECTORS/PERFORMANCE
Secondary emission monitors at the Bevatron-Bevalac, 4:39457 (LBL-8808)
Tests of a new secondary emission chamber at the AGS (Extracted beam intensity), 4:39435 (BNL-25795)
SECURITY/EQUIPMENT
Commercially available video motion detectors, 4:38295 (SAND-79-0186)
SECURITY SEALS/MANUALS
Security seal handbook, 4:38294 (SAND-78-0400)
SEDIMENTS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SEDIMENTS/SAMPLING
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SEISMIC ARRAYS/PERFORMANCE
Relationships between noise and mb bias applied to seismic station site selection and performance evaluation. Technical report, 4:39525 (AD-A-058227)
SEISMIC DETECTION/DATA PROCESSING
Seismic monitoring: a unified system for research and verifications, 4:39714 (UCRL-52665)
SEISMIC DETECTORS/ELECTRONIC CIRCUITS
Unit for automatically constructing curves of the fall in intensity of seismic signals, 4:39718
SEISMIC DETECTORS/PERFORMANCE
Unit for automatically constructing curves of the fall in intensity of seismic signals, 4:39718
SEISMIC SOURCES/DESIGN
Technique of grouping electrospark sources, 4:39715
SEISMIC SOURCES/OPTIMIZATION
Calculating group explosion parameters with the purpose of increasing the seismic effect, 4:39716
SEISMIC SURVEYS/CORRELATIONS
Use of data from deep seismic probing in the interpretation of gravimetric data, 4:39723
SEISMIC SURVEYS/DATA ANALYSIS
Seismic surveys by reflected waves on the Russian platform, 4:39713
SEISMIC SURVEYS/EQUIPMENT
Use of simultaneous grouping of sources and receivers of elastic oscillations in seismic surveys, 4:39717
SELENIUM 75/RETENTION
Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se-selenomethionine, 4:39689 (ANL-78-65(Pt.2))
SELENIUM 75/TISSUE DISTRIBUTION
Retention and distribution of ^{75}Se following intravenous injection of ^{75}Se-selenomethionine, 4:39689 (ANL-78-65(Pt.2))
SEMICONDUCTOR LASERS/ELECTRON TUBES
Possibility of lowering the acceleration voltage of a laser electron-beam tube, 4:39308
SEMICONDUCTOR LASERS/EMISSION SPECTRA
Optically pumped Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ heterojunction lasers with matched gratings at the interface, 4:39309
SEMICONDUCTOR LASERS/FEEDBACK
Distributed-feedback semiconductor lasers operating in higher Bragg interaction orders, 4:39316
SEMICONDUCTOR LASERS/GAIN
Optically pumped Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ heterojunction lasers with matched gratings at the interface, 4:39309
SEMICONDUCTOR LASERS/OPTICAL PUMPING
Optically pumped Pb/sub 1-x/Sn/sub x/Se/sub 1-y/Te/sub y/ heterojunction lasers with matched gratings at the interface, 4:39309
SEMICONDUCTOR LASERS/THRESHOLD ENERGY
Distributed-feedback semiconductor lasers operating in higher Bragg interaction orders, 4:39316
SEMICONDUCTOR MATERIALS
(See also specific semiconductor materials.)
SEMICONDUCTOR MATERIALS/PHYSICAL RADIATION EFFECTS
Mechanism of low-temperature formation of Watkins-type radiation defects in semiconductors, 4:39198
SENSIBLE HEAT STORAGE/SIMULATION
Stratified thermal storage in residential solar energy applications, 4:38504 (COO-4523-1)
SENSIBLE HEAT STORAGE/STRATIFICATION
Stratified thermal storage in residential solar energy applications, 4:38504 (COO-4523-1)
SEPTUM MAGNETS/DESIGN
Septum magnet coil design principles (Guide to using the computer code TRIM for coil design), 4:39445 (DOE/TIC-10045)
SET THEORY
Study of set-theoretic information processing, 4:38859 (UCRL-13970)
SEWAGE
See LIQUID WASTES
SEWAGE SLUDGE/BIOLOGICAL EFFECTS
Comparison of sludge and fertilizer applications on establishment and growth of seedlings of two sweetgum ecotypes endomycorrhizal with Glomus mosseae and G. etunicatus. Establishment and progress report, 4:39658 (SRO-0870-5)
SEWAGE TREATMENT
See WASTE PROCESSING
SEYFERT GALAXIES/X-RAY SPECTRA
X-ray observations of a flare in NGC4151 from OSO-8, 4:39739 (N-78-31021)
SGHWR REACTOR/CALANDRIAS
Release of alloying constituents of stainless steel in SGHWR calandria environment, 4:38649
SGHWR REACTOR/COOLANT CLEANUP SYSTEMS
Chemistry of the PSGHWR heavy water moderator system, 4:38643
SGHWR REACTOR/DECONTAMINATION
Decontamination of the SGHWR prototype, 4:38654
SGHWR REACTOR/FISSION PRODUCT RELEASE
Release of radioiodines from defective fuel in WSGHWR, 4:38644
SGHWR REACTOR/FUEL ELEMENT FAILURE
Release of radioiodines from defective fuel in WSGHWR, 4:38644
SGHWR REACTOR/PRIMARY COOLANT CIRCUITS
Examination of radioactive particles in WSGHWR coolant circuits using scanning electron microscope autoradiography, 4:38645
SGHWR REACTOR/RADIOACTIVITY TRANSPORT
Examination of radioactive particles in WSGHWR coolant circuits using scanning electron microscope autoradiography, 4:38645
SGHWR REACTOR/REACTOR COOLING SYSTEMS
Some aspects of water chemistry in the CSGHWR, 4:38656

SGHWR REACTOR/WATER CHEMISTRY
Some aspects of water chemistry in the CSGHWR, 4:38656
SHALE OIL/PRODUCTION
The relative costs of producing syncrude from oil shales of various grades under varying conditions, 4:38197 (N-78-31268)
SHALE OIL/RESERVES
Energy analysis and oil shale reserves, 4:38187 (N-78-31584)
SHALE TAR WATER/BIOLOGICAL EFFECTS
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
SHALE TAR WATER/ENVIRONMENTAL EFFECTS
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
SHALE TAR WATER/TOXICITY
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
SHALES
See also OIL SHALES
SPENT SHALES
SHALES/CHEMICAL ANALYSIS
Use of weighted x-ray diffraction data for semi-quantitative estimation of minerals in low-temperature ashes of bituminous coal and in shale, 4:39211 (METC/CR-79/5)
SHEARER LOADERS
See CUTTER LOADERS
SHEATHS (FUEL)
See FUEL CANS
SHELLS (CONTAINMENT)
See CONTAINMENT SHELLS
SHF RADIATION
See RADIOWAVE RADIATION
SHIPMENT
See TRANSPORT
SHIPS
See also BARGES
TANKER SHIPS
SHIPS/MATERIALS HANDLING
Coal cutter vehicle (Patent; unloading coal), 4:38122
SHIVA FACILITY/DATA ACQUISITION SYSTEMS
Electronics of the target diagnostics system for the Shiva Laser Fusion Facility, 4:40014 (UCRL-52521)
SHIVA FACILITY/PLASMA DIAGNOSTICS
Electronics of the target diagnostics system for the Shiva Laser Fusion Facility, 4:40014 (UCRL-52521)
SHOCK HEATING/MEASURING METHODS
High temperature science: future needs and anticipated development in high-density shock-wave research, 4:39946 (UCID-18072)
SHOCK WAVES/COMPUTER CALCULATIONS
Solution of non-linear differential equations by discrete least squares, 4:40045
SHOCK WAVES/RESEARCH PROGRAMS
High temperature science: future needs and anticipated development in high-density shock-wave research, 4:39946 (UCID-18072)
SHORES/CONTAMINATION
The Amoco Cadiz oil spill. A preliminary scientific report. Special report, 4:39618 (PB-285805)
SHRUBS/POPULATION DYNAMICS
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
SHRUBS/SPECIES DIVERSITY
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
SHUTIN PRESSURE
See RESERVOIR PRESSURE
SID
See SUDDEN IONOSPHERIC DISTURBANCE
SIGMA MINUS/BOUND STATE
(K,π) reaction at Brookhaven (Angular distribution, 800 MeV/c, J, $\Sigma^{-12}C$, Σ-n bound state), 4:39822 (BNL-25879)
SIGMA PARTICLES
See also SIGMA MINUS
SIGMA PARTICLES/MASS SPECTRA
ΛK and ΣK systems observed in π^+ interactions at 10.3 GeV/c (Peripheral phase space, broad theshold enhancements), 4:39864
SILANES/PHOTOIONIZATION
Laser photodetachment of electrons from O_2^- in nonpolar liquids), 4:39250
SILASTIC/TENSILE PROPERTIES
Development of alternate silicone potting compounds. Vol.4. Development of a substitute for Dow Corning's aerospace sealant DC 93-120 resin cured with DC 93-122 curing agent, 4:39182 (UCRL-52434(Vol.4))
SILICA/CHEMICAL ANALYSIS
Research ambient air industrial hygiene survey of the Pittsburgh Energy Technology Center at Bruceton, Pennsylvania. Final report, April 15-August 30, 1978, 4:38043 (COO-4748-1)
SILICON/AUGER ELECTRON SPECTROSCOPY
High-resolution LMM Auger spectra from argon implanted in Be and Si, 4:39153
SILICON/CRYSTAL DOPING
New materials properties achievable by ion implantation doping and laser processing, 4:39196 (CONF-781121-22)
SILICON/CRYSTAL GROWTH
Continuous Czochralski process development. LSSA large area silicon sheet task. Annual report, October 1977-September 1978, 4:38375 (DOE/JPL/954887-4)
Development of a model and computer code to describe solar grade silicon production processes. Fourth quarterly report, July 1-September 30, 1978, 4:38398 (DOE/JPL/954862-4)
Silicon sheet growth development of the large area silicon sheet task of the low cost silicon solar array project. Third quarterly progress report, April 1-June 30, 1978, 4:38376 (DOE/JPL/954888-3)
SILICON/ELECTRICAL PROPERTIES
Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977-September 1978, 4:38370 (COO-4546-5)
SILICON/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
SILICON/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
Spectral method for determining impurities in anthracite and oil coke, 4:38084
SILICON/ION EXCHANGE
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
SILICON/ION IMPLANTATION
New materials properties achievable by ion implantation doping and laser processing, 4:39196 (CONF-781121-22)
SILICON/METALLURGICAL EFFECTS
Correlation between acoustic emission and microstructure in aluminum alloys, 4:39103 (UCRL-81879)
SILICON/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
SILICON/OPTICAL PROPERTIES
Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977-September 1978, 4:38370 (COO-4546-5)
SILICON/PION PLUS REACTIONS
Low energy π^+ scattering from light nuclei, 4:39896
SILICON/SURFACE COATING
Radio-frequency-sputtered tetragonal barium titanate films on silicon, 4:39180
SILICON/VAPOR PLATING
Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977-September 1978, 4:38370 (COO-4546-5)
SILICON 28/GIANT RESONANCE
Inelastic electron scattering in $_{28}$si between 4 MeV and 50 MeV excitation energy. Master's thesis, 4:39899 (AD-A-057898)
SILICON 28 TARGET/ELECTRON REACTIONS
Inelastic electron scattering in $_{28}$si between 4 MeV and 50 MeV excitation energy. Master's thesis, 4:39899 (AD-A-057898)
SILICON ALLOYS/ANNEALING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
SILICON ALLOYS/POSITRON CHANNELING
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
SILICON ALLOYS/PRECIPITATION
Study of precipitation phenomena in aluminum alloys by positron annihilation, 4:39094 (SAND-79-0727C)
SILICON CARBIDES/MATERIALS TESTING
Tests and studies of USSR materials at the US coal burning MHD facility UTSI-2, 4:38967 (CONF-7805142-1)
SILICON HYDRIDES
See SILANES
SILICON NITRIDES/CHEMICAL PROPERTIES
AES investigation of the chemical structure of silicon oxy-nitride films, 4:39233
SILICON NITRIDES/MATERIALS TESTING
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)

SILICON NITRIDES/OXYGEN ADDITIONS
AES investigation of the chemical structure of silicon oxy-nitride films, 4:39233
SILICON NITRIDES/RESEARCH PROGRAMS
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technology. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
SILICON OXIDES/CATALYTIC EFFECTS
Properties of supported metal catalysts, 4:39226 (LBL-8975)
SILICON OXIDES/CHEMICAL BONDS
Bonding at the Si (111)-SiO_2 interface: stoichiometry and kinetics probed with synchrotron radiation photoemission spectroscopies, 4:39189
SILICON OXIDES/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
SILICON OXIDES/STOICHIOMETRY
Bonding at the Si (111)-SiO_2 interface: stoichiometry and kinetics probed with synchrotron radiation photoemission spectroscopies, 4:39189
SILICON SOLAR CELLS/ANTIREFLECTION COATINGS
Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N-78-30656)
SILICON SOLAR CELLS/DESIGN
Array Automated Assembly, Phase 2. Quarterly report for the quarter ending June 30, 1978, 4:38372 (DOE/JPL/954853-3)
SILICON SOLAR CELLS/EFFICIENCY
Amorphous-silicon solar cells. Annual report, July 1, 1976-June 30, 1977, 4:38392 (SAN-1286-4)
SILICON SOLAR CELLS/ELECTRICAL PROPERTIES
Characterization of solar cells for space applications. Volume 2: electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature, 4:38387 (N-78-30662)
SILICON SOLAR CELLS/ENCAPSULATION
Investigation of test methods, material properties, and processes for solar cell encapsulants. Ninth quarterly progress report, May 12, 1978-August 12, 1978, 4:38371 (DOE/JPL/954527-7)
SILICON SOLAR CELLS/FABRICATION
Amorphous-silicon solar cells. Annual report, July 1, 1976-June 30, 1977, 4:38392 (SAN-1286-4)
Glow discharge amorphous silicon. Final report of innovative research program subtask, December 1977-September 1978, 4:38370 (COO-4546-5)
Phase 2. Array automated assembly task, low cost silicon solar array project. Quarterly technical report no. 2, April 1-June 30, 1978, 4:38374 (DOE/JPL/954865-3)
Silicon schottky photovoltaic diodes for solar energy conversion. Final report, 1 June 1975-31 May 1978, 4:38391 (PB-283998)
SILICON SOLAR CELLS/PERFORMANCE
Silicon schottky photovoltaic diodes for solar energy conversion. Final report, 1 June 1975-31 May 1978, 4:38391 (PB-283998)
SILICON SOLAR CELLS/PROTECTIVE COATINGS
Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N-78-30656)
SILICON SOLAR CELLS/SCREEN PRINTING
Array Automated Assembly, Phase 2. Quarterly report for the quarter ending June 30, 1978, 4:38372 (DOE/JPL/954853-3)
SILICON SOLAR CELLS/SPECTRALLY SELECTIVE SURFACES
Chemical vapor deposition of spectrally selective surfaces for high-temperature photothermal conversion, 4:38393
SILICONES
See also SILASTIC
SILICONES/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SILICONES/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SILICONES/QUANTITATIVE CHEMICAL ANALYSIS
FE-NMR analysis of silane hydrogen, phenyl, and vinyl content of several siloxane pre-polymer materials, 4:39200 (MHSMP-79-15)
SILOXANES
See also SILICONES
SILOXANES/QUANTITATIVE CHEMICAL ANALYSIS
FE-NMR analysis of silane hydrogen, phenyl, and vinyl content of several siloxane pre-polymer materials, 4:39200 (MHSMP-79-15)
SILVER/ELECTRODES
Construction and thermodynamic performance of an Ag-AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
SILVER/ION CHANNELING
Resonant coherent excitation of channeled ions, 4:39170
SILVER/METALLURGICAL EFFECTS
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
SILVER/SORPTIVE PROPERTIES
ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions, 4:39224 (LBL-8975)
SILVER 107/ENERGY LEVELS
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, total and differential cross sections), 4:39909 (ANL/NDM-46)
SILVER 107 TARGET/NEUTRON REACTIONS
Fast-neutron total and scattering cross sections of ^{107}Ag in the MeV region (0.25 to 4.5 MeV, total and differential cross sections), 4:39909 (ANL/NDM-46)
SILVER ALLOYS/CORROSION PROTECTION
Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
SILVER BROMIDES/CRYSTAL GROWTH
Passive particle dosimetry. Final report, 17 November 1970-30 June 1977, 4:39493 (N-78-27965)
SILVER CHLORIDES/CRYSTAL GROWTH
Passive particle dosimetry. Final report, 17 November 1970-30 June 1977, 4:39493 (N-78-27965)
SILVER CHLORIDES/SURFACE COATING
Construction and thermodynamic performance of an Ag-AgCl reference electrode for use in high temperature aqueous environments containing H_2 and H_2S, 4:39195
SILVER COMPOUNDS/CATALYTIC EFFECTS
Removal of organic material from recycle nitric acid by ozone, 4:38240 (ORNL/TM-6672)
SILVER-CADMIUM BATTERIES/PERFORMANCE TESTING
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
SILVER-ZINC BATTERIES/ANODES
Observations of an operating zinc-pore electrode. Interim technical report, 4:38848 (AD-A-059300)
SILVER-ZINC BATTERIES/BATTERY SEPARATORS
Galvanic cell having rechargeable zinc electrode (Patent; mechanical-chemical approach), 4:38853
SILVER-ZINC BATTERIES/PERFORMANCE TESTING
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
SIMULATORS/FABRICATION
Mine machinery trainer, development and fabrication, 4:38100 (PB-284196)
SINUSES/EPITHELIUM
Quantitative histology of human paranasal sinus and mastoid air cell epithelia, 4:39677 (ANL-78-65(Pt.2))
SINUSES/NEOPLASMS
Radium-induced malignant tumors of the mastoid and paranasal sinuses, 4:39672 (ANL-78-65(Pt.2))
SITES (REACTOR)
See REACTOR SITES
SKELETON/RADIATION DOSES
Distribution of injected plutonium in the skeleton and certain soft tissues (^{239}Pu), 4:39688 (ANL-78-65(Pt.2))
Measurements of ^{241}Am in vivo at long times after inhalation, 4:39684 (ANL-78-65(Pt.2))
Plutonium injection cases: an update to 1977 (^{238}Pu, ^{239}Pu), 4:39682 (ANL-78-65(Pt.2))
SKIN/PATHOLOGICAL CHANGES
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
SLABS/ASYMPTOTIC SOLUTIONS
Self-similar power-driven expansion into vacuum, 4:40017
SLABS/NUMERICAL SOLUTION
Self-similar power-driven expansion into vacuum, 4:40017
SLAGS
Study of the influence of a slag film on the characteristics of electrodes in the MHD generator channel of the U-02 facility, 4:38974 (CONF-781009-)
SLAGS/CHEMICAL COMPOSITION
Materials, 4:39165
SLAGS/CORROSIVE EFFECTS
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
SLAGS/ELECTRIC CONDUCTIVITY
Discharge and corrosion characteristics of slagging metal electrodes, 4:38963 (CONF-781009-)
Materials, 4:39165
SLAGS/THERMAL DIFFUSIVITY
Materials, 4:39165
SLAGS/VISCOSITY
Gas generator research and development: BI-GAS Process. Interim report, July 1977-June 30, 1978, 4:38049 (FE-1207-49)
Materials, 4:39165

SLUDGES/CHEMICAL COMPOSITION
Lime/limestone scrubbing sludge characterization - Shawnee Test Facility. Final report March 1975-June 1976, 4:39352 (PB-284111)
SLUDGES/SEDIMENTATION
Lime/limestone scrubbing sludge characterization - Shawnee Test Facility. Final report March 1975-June 1976, 4:39352 (PB-284111)
SLUDGES/WASTE DISPOSAL
Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final report, 4:38164 (PB-283719)
SLUGS (FUEL)
See FUEL RODS
SLURRY PIPELINES/COMPARATIVE EVALUATIONS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
SLURRY PIPELINES/ECONOMIC ANALYSIS
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 3. Coal slurry pipelines. Final report, 4:38112 (DOE/TIC-10053(Vol.3))
SLURRY PIPELINES/ECONOMICS
Water pollution control for coal slurry pipelines. Final report, 4:38121 (SAI-068-79-516)
SLURRY PIPELINES/TECHNOLOGY ASSESSMENT
The hydraulic transportation of oil shale. Research report, 4:38186 (PB-283817)
SLURRY PIPELINES/WATER POLLUTION CONTROL
Water pollution control for coal slurry pipelines. Final report, 4:38121 (SAI-068-79-516)
SLURRY PIPELINES/WATER REQUIREMENTS
Rocky Mountain coal for southern California's coal-fired electric power generation, 4:38128 (LA-6915-MS)
SMOKATRON
See ELECTRON-RING ACCELERATORS
SNR REACTOR
See SNR-1 REACTOR
SNR-1 REACTOR/FUEL PINS
Possibilities of application of experimental Kfk results from BR2 on SNR designs, 4:38676 (INIS-mf-4426)
SNR-300 REACTOR
See SNR-1 REACTOR
SODA ASH
See SODIUM CARBONATES
SODIUM/ATOM-ATOM COLLISIONS
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978-May 31, 1979 (Summaries of research activities at Univ., Missouri), 4:39791 (COO-2718-7)
SODIUM/EMISSION SPECTROSCOPY
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
SODIUM/HEAVY ION REACTIONS
Tables of light-fragment inclusive cross sections in relativistic heavy ion collisions. Part I. C + C, C + Pb, Ne + NaF, Ne + Cu, Ne + Pb $\rightarrow \pi^{+-}$, p, d, t, ^{3}He; E/sub BEAM/ = 800 MeV/A (800 MeV/A), 4:39887 (LBL-8463)
SODIUM/ION-ATOM COLLISIONS
Observation of luminescent spectra in low energy ion-neutral collisions. Progress report, June 1, 1978-May 31, 1979 (Summaries of research activities at Univ., Missouri), 4:39791 (COO-2718-7)
SODIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
SODIUM/REMOVAL
Sodium technology progress report, October-December 1978 (LMFBR), 4:38673 (HEDL-TME-78-93)
SODIUM 22/HIGH SPIN STATES
Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ $\simeq$ 14.3 and 25.2 MeV, 4:39891
SODIUM 22/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
SODIUM 23/HIGH SPIN STATES
Enhancements in the p and d exit channels of ^{12}C + ^{12}C: E/sub c.m./ $\simeq$ 14.3 and 25.2 MeV, 4:39891
SODIUM 24/ISOTOPE PRODUCTION
Spallation of aluminum by 300 GeV protons, 4:39901
SODIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
SODIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
SODIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
SODIUM CARBONATES
See also TRONA
SODIUM CARBONATES/CORROSIVE EFFECTS
Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978-31 May 1979, 4:39091 (COO-2960-3)
SODIUM CHLORIDES/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
SODIUM CHLORIDES/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SODIUM CHLORIDES/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SODIUM CHLORIDES/MINERALOGY
Structural petrology of undeformed and experimentally deformed halite samples from USERDA site No. 7 and No. 9, 4:39726 (SAND-78-7076)
SODIUM COMPOUNDS/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
SODIUM COMPOUNDS/MONITORING
Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976-February 1977, 4:39563 (PB-285059)
SODIUM SULFATES/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SODIUM SULFATES/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SODIUM SULFIDES/SOLUBILITY
Solubility, stability, and electrochemical studies of sulfur-sulfide solutions in organic solvents, 4:38849 (N-78-28624)
SODIUM-SULFUR BATTERIES/BATTERY SEPARATORS
Sulfur cell construction and method (Patent; carbon mesh wrapping between β-alumina and polysulfide electrolytes), 4:38850
SODIUM-SULFUR BATTERIES/CATHODES
Electrochemical storage cell (Patent), 4:38851
Solubility, stability, and electrochemical studies of sulfur-sulfide solutions in organic solvents (100 to 120°C), 4:38849 (N-78-28624)
SODIUM-SULFUR BATTERIES/CHEMICAL REACTION KINETICS
Solubility, stability, and electrochemical studies of sulfur-sulfide solutions in organic solvents (100 to 120°C), 4:38849 (N-78-28624)
SODIUM-SULFUR BATTERIES/ELECTROLYTES
Sulfur cell construction and method (Patent; carbon mesh wrapping between β-alumina and polysulfide electrolytes), 4:38850
SODIUM-SULFUR BATTERIES/PERFORMANCE TESTING
Experimental study of new electrochemical systems for military high-power applications, 4:38839 (BMVg-FBWT-78-20)
SOIL MECHANICS/MECHANICAL TESTS
Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report, 4:39724 (EPRI-NP-920)
SOIL MECHANICS/REVIEWS
Evaluation of in situ testing methods for high-amplitude, dynamic property determination. Final report, 4:39724 (EPRI-NP-920)
SOILS/ARTHROPODS
Distribution and abundance of soil arthropods in the northern Mojave desert, 4:39595 (UCLA-12-1190)
SOILS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SOILS/HEAT STORAGE
Solar energy storage and utilization (Patent), 4:38508

SOILS/MOISTURE
The effects of moisture content and soil composition upon air/ground tactical nuclear environments. Final report, 4:39522 (AD-A-059705)
SOILS/RADIONUCLIDE MIGRATION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
Radioactivity associated with biota and soils of the 216-A-24 Crib, 4:38271 (PNL-1948)
SOILS/SAMPLING
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SOILS/SORPTIVE PROPERTIES
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
SOLAR ABSORBERS/BLACK COATINGS
Relationship of optical degradation to surface morphology changes in solar absorbers, 4:38502
SOLAR ABSORBERS/MATERIALS
Radiation energy converter, 4:38503
SOLAR ACTIVITY
See also SOLAR FLARES
SOLAR WIND
SOLAR X-RAY BURSTS
SUNSPOTS
SOLAR ACTIVITY/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR ACTIVITY/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
SOLAR AIR CONDITIONERS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR AIR CONDITIONING/BIBLIOGRAPHIES
Solar space heating and air conditioning. volume 2. 1976-august, 1977 (citations from the NTIS data base). Report for 1976-August 1977, 4:38475 (NTIS/PS-78/1014)
Solar space heating and air conditioning. volume 3. September, 1977-september, 1978 (citations from the ntis data base). Report for September 1977-September 1978, 4:38476 (NTIS/PS-78/1015)
Solar space heating and air conditioning. volume 3. September, 1977-September, 1978 (citations from the Engineering Index data base). Report for sep 77-sep 78, 4:38477 (NTIS/PS-78/1017)
Solar thermal heating and cooling, 1978. Quarterly reports, 4:38478 (NTISUB/D-452)
Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports, 4:38349 (NTISUB/D-450)
SOLAR AIR CONDITIONING/MARKETING RESEARCH
A socio-economic and marketing study for a Puerto Rico Economic Development Administration (fomento) solar cooled factory in Puerto Rico. Final report, 4:38479 (PB-284138)
SOLAR AIR CONDITIONING/SOCIAL IMPACT
Social assessment of on-site solar energy technologies. Topical report, 4:38366 (HCP/R4040-02)
SOLAR AIR CONDITIONING/SOCIO-ECONOMIC FACTORS
A socio-economic and marketing study for a Puerto Rico Economic Development Administration (fomento) solar cooled factory in Puerto Rico. Final report, 4:38479 (PB-284138)
SOLAR AIR HEATERS/CERTIFICATION
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
SOLAR AIR HEATERS/FABRICATION
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
SOLAR AIR HEATERS/PERFORMANCE TESTING
Development, testing, and certification of Owens-Illinois Model SEC-601 Solar Energy Collector System. Final report, 4:38490 (DOE/NASA/TM-78223)
Long term weathering effects on the thermal performance of the Solaron (air) solar collector, 4:38488 (DOE/NASA/CR-161166)
SOLAR AIR HEATERS/WEATHERING
Long term weathering effects on the thermal performance of the Solaron (air) solar collector, 4:38488 (DOE/NASA/CR-161166)
SOLAR CELL ARRAYS/ANTIREFLECTION COATINGS
Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N-78-30656)
SOLAR CELL ARRAYS/ATTITUDE CONTROL
Thermal vacuum life test of an MSDS solar array drive (MSDS No. 2). First 2 years of operation, 4:38382 (N-78-28475)
SOLAR CELL ARRAYS/COST
SAMICS marketing and distribution model, 4:38385 (N-78-30658)
SOLAR CELL ARRAYS/DESIGN
Array Automated Assembly, Phase 2. Quarterly report for the quarter ending June 30, 1978, 4:38372 (DOE/JPL/954853-3)
Description of the University of Texas at Arlington Solar Energy Research Facility photovoltaic/thermal residential system, 4:38397 (COO-4577-5)
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2, 4:38379 (N-78-27531)
Study of SEP solar array modifications. Final report, 4:38386 (N-78-30659)
SOLAR CELL ARRAYS/ENCAPSULATION
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2, 4:38379 (N-78-27531)
Investigation of test methods, material properties, and processes for solar cell encapsulants. Ninth quarterly progress report, May 12, 1978-August 12, 1978, 4:38371 (DOE/JPL/954527-7)
SOLAR CELL ARRAYS/FABRICATION
Array automated assembly. Phase 2: quarterly report for the quarter ending September 30, 1978, 4:38373 (DOE/JPL/954853-4)
SOLAR CELL ARRAYS/MANUFACTURING
SAMICS marketing and distribution model, 4:38385 (N-78-30658)
SOLAR CELL ARRAYS/PERFORMANCE TESTING
Additional thermal cycling tests on solar cell panel samples under vacuum conditions. Final report, 4:38389 (N-78-31585)
SOLAR CELL ARRAYS/PROTECTIVE COATINGS
Array automated assembly. Phase 2: quarterly report for the quarter ending September 30, 1978, 4:38373 (DOE/JPL/954853-4)
Spraylon fluorocarbon encapsulation for silicon solar cell arrays, phase 3. Final report, 4:38384 (N-78-30656)
SOLAR CELL ARRAYS/SCREEN PRINTING
Array automated assembly. Phase 2: quarterly report for the quarter ending September 30, 1978, 4:38373 (DOE/JPL/954853-4)
SOLAR CELL ARRAYS/SOLAR CONCENTRATORS
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2, 4:38379 (N-78-27531)
SOLAR CELL ARRAYS/TECHNOLOGY ASSESSMENT
Evaluation of solar cells and arrays for potential solar power satellite applications. Final report, 4:38402 (N-78-27538)
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 1, 4:38378 (N-78-27530)
SOLAR CELL ARRAYS/THERMAL CYCLING
Additional thermal cycling tests on solar cell panel samples under vacuum conditions. Final report, 4:38389 (N-78-31585)
SOLAR CELLS
See also CADMIUM SULFIDE SOLAR CELLS
GALLIUM ARSENIDE SOLAR CELLS
SILICON SOLAR CELLS
SOLAR CELLS/ANTIREFLECTION COATINGS
Evaluation of glass resin coatings for solar cell applications. Final report, 4:38381 (N-78-27540)
SOLAR CELLS/COST BENEFIT ANALYSIS
Outline of cost-benefit analysis and a case study, 4:38390 (N-78-31954)
SOLAR CELLS/PROTECTIVE COATINGS
Measurements of material properties for solar cells. Final report, 7 February 1977-6 March 1978, 4:38388 (N-78-31531)
SOLAR CONCENTRATORS
See also MIRRORS
SOLAR CONCENTRATORS/MATHEMATICAL MODELS
Helios model for the optical behavior of reflecting solar concentrators, 4:38496 (SAND-76-0347)
SOLAR COOLING SYSTEMS
See also SOLAR AIR CONDITIONERS
SOLAR COOLING SYSTEMS/ABSORPTION REFRIGERATION CYCLE
Proceedings of the desiccant cooling conference of November 16, 1977, 4:38481 (SERI-22)
SOLAR COOLING SYSTEMS/CLASSIFICATION
Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL-8814)

SOLAR COOLING SYSTEMS/CORROSION INHIBITORS
Corrosion inhibitors for solar heating and cooling systems, 4:38473 (N-78-30202)
SOLAR COOLING SYSTEMS/DESIGN
System design package for solar heating and cooling system installed at Akron, Ohio, 4:38464 (DOE/NASA/CR-161192)
SOLAR COOLING SYSTEMS/HYBRID SYSTEMS
Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL-8814)
SOLAR COOLING SYSTEMS/INSTALLATION
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR COOLING SYSTEMS/MAINTENANCE
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR COOLING SYSTEMS/MATERIALS TESTING
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
SOLAR COOLING SYSTEMS/MEETINGS
Proceedings of the desiccant cooling conference of November 16, 1977, 4:38481 (SERI-22)
SOLAR COOLING SYSTEMS/OPERATION
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR COOLING SYSTEMS/SIMULATION
Solar heating and cooling of buildings (SHACOB) commercialization report. Part B. Analysis of market development. Volume II. Technical report. Final report, 4:38465 (DOE/TIC-10071)
SOLAR CORONA/JOULE HEATING
Reverse current in solar flares, 4:39749 (N-78-31031)
SOLAR DISTILLATION/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR DRYERS/DESIGN
Solar supplement to laundry drying. Annual progress report, October 31, 1977-October 31, 1978, 4:38486 (COO-4517-1)
SOLAR ELECTRIC PROPULSION/SOLAR CELL ARRAYS
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 2, 4:38379 (N-78-27531)
SOLAR ELECTRIC PROPULSION/TECHNOLOGY ASSESSMENT
Study of SEP solar array modifications. Final report, 4:38386 (N-78-30659)
SOLAR ENERGY
Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper, 4:38358 (PB-285129)
SOLAR ENERGY/BIBLIOGRAPHIES
Solar energy in agriculture, 1970-1977: 236 citations. Quick bibliography series, 4:38487 (NAL-BIBL-78-04)
SOLAR ENERGY/COMMERCIALIZATION
Implementation of state solar incentives: research, development, and demonstration programs, 4:38353 (SERI/TR-51-161)
Solar energy commercialization and the labor market, 4:38367 (SERI/TP-53-123)
SOLAR ENERGY/FINANCIAL INCENTIVES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
Implementation of state solar incentives: financial programs, 4:38361 (SERI/TR-51-160)
SOLAR ENERGY/GOVERNMENT POLICIES
Analysis of Federal incentives used to stimulate energy production, 4:38912 (PNL-2410-1(Rev.))
Potential for state government assistance to community solar energy enterprises, 4:38369
SOLAR ENERGY/IMPLEMENTATION
Implementation of state solar incentives: financial programs, 4:38361 (SERI/TR-51-160)
Implementation of state solar incentives: state testing and certification, 4:38362 (SERI/TR-51-162)
SOLAR ENERGY/LABOR
Solar energy commercialization and the labor market, 4:38367 (SERI/TP-53-123)
SOLAR ENERGY/RESEARCH PROGRAMS
Energy research and development programme: first status report (1975-1976) (Book), 4:38890
Implementation of state solar incentives: research, development, and demonstration programs, 4:38353 (SERI/TR-51-161)
Reference data: a basic plan for research and development, 4:38509
SOLAR ENERGY/STATE GOVERNMENT
Potential for state government assistance to community solar energy enterprises, 4:38369
SOLAR ENERGY/USES
Earth, an open system. The use of solar energy, 4:38355
SOLAR ENERGY CONVERSION/HYDROGEN PRODUCTION
Photobiological production of hydrogen: a solar energy conversion option, 4:38309 (SERI/TR-33-122)
Recent developments in hydrogen production by microalgae, 4:38310
Solar energy conversion to hydrogen by algae and bacteria, 4:38308 (CONF-780161-1)
SOLAR ENERGY CONVERSION/PHOTOSYNTHESIS
Biological solar energy conversion approaches to overcome yield stability and product limitations. Progress report no. 6, 1 October 1977-31 March 1978, 4:39555 (PB-284823)
SOLAR ENERGY RESEARCH INSTITUTE
SERI: the first year, 4:38352 (SERI/SP-11-142)
SOLAR FLARES/ELECTRIC CURRENTS
Reverse current in solar flares, 4:39749 (N-78-31031)
SOLAR FLARES/GAMMA SPECTRA
Solar gamma rays above 8 MeV, 4:39751 (N-78-32031)
SOLAR FLARES/JOULE HEATING
Reverse current in solar flares, 4:39749 (N-78-31031)
SOLAR FLARES/MATHEMATICAL MODELS
The primary energy release in reconnection flare models. Interim report, 4:39743 (AD-A-058325)
SOLAR FLARES/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR FLARES/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
SOLAR HEATING/BIBLIOGRAPHIES
Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports, 4:38349 (NTISUB/D-450)
SOLAR HEATING SYSTEMS
See also PASSIVE SOLAR HEATING SYSTEMS
SOLAR-ASSISTED HEAT PUMPS
SOLAR HEATING SYSTEMS/CLASSIFICATION
Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL-8814)
SOLAR HEATING SYSTEMS/CONTROL SYSTEMS
Design package for programmable controller and hydronic subsystem, 4:38462 (DOE/NASA/CR-161151)
SOLAR HEATING SYSTEMS/CORROSION INHIBITORS
Corrosion inhibitors for solar heating and cooling systems, 4:38473 (N-78-30202)
SOLAR HEATING SYSTEMS/DESIGN
Solar heating and cooling system design and development. Status summary through December 1977, 4:38472 (N-78-28613)
System design package for solar heating and cooling system installed at Akron, Ohio, 4:38464 (DOE/NASA/CR-161192)
SOLAR HEATING SYSTEMS/DRAIN-DOWN SYSTEMS
Solar heater freeze protection system (Patent), 4:38483
SOLAR HEATING SYSTEMS/FREEZE PROTECTION
Solar heater freeze protection system (Patent), 4:38483
SOLAR HEATING SYSTEMS/HYBRID SYSTEMS
Classification scheme for the common passive and hybrid heating and cooling systems, 4:38471 (LBL-8814)
SOLAR HEATING SYSTEMS/INSTALLATION
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR HEATING SYSTEMS/MAINTENANCE
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR HEATING SYSTEMS/MATERIALS TESTING
Composition stability and degradation products of selected materials for solar heating and cooling, 4:38480 (SAND-78-0681)
SOLAR HEATING SYSTEMS/OPERATION
Installation package for the solaron solar subsystems, 4:38463 (DOE/NASA/CR-161190)
SOLAR HEATING SYSTEMS/PERFORMANCE
Hull residence: a passive solar hybrid system, 4:38432 (CONF-780337-P2)
SOLAR HEATING SYSTEMS/RETROFITTING
Greenbelt community project: solar energy retrofit for a multi-family dwelling, 4:38474 (N-78-31539)
SOLAR HEATING SYSTEMS/SIMULATION
Solar heating and cooling of buildings (SHACOB) commercialization report. Part B. Analysis of market development. Volume II. Technical report. Final report, 4:38465 (DOE/TIC-10071)

SOLAR HEATING SYSTEMS/SOCIO-ECONOMIC FACTORS
Macroeconomic and sector implications of installing 2.2 million residential solar units, 4:38360 (DOE/EIA-0102/51)
SOLAR INDUSTRY/LABOR RELATIONS
Organized labor and solar energy, 4:38368 (SERI/TR-62-148)
SOLAR INDUSTRY/MATHEMATICAL MODELS
SAMICS marketing and distribution model, 4:38385 (N-78-30658)
SOLAR INDUSTRY/SIMULATION
SAMICS marketing and distribution model, 4:38385 (N-78-30658)
SOLAR INDUSTRY/STANDARDS
Implementation of state solar incentives: state testing and certification, 4:38362 (SERI/TR-51-162)
SOLAR PARTICLES/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR PARTICLES/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
SOLAR PONDS
Office building for an era of transitions: application of the skytherm system of passive heating and cooling to a moderate density office building, 4:38427 (CONF-780337-P1)
SOLAR PONDS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR PONDS/PERFORMANCE
Evaluation of a large nonconvective solar pond, 4:38492 (MLM-2606(OP))
SOLAR PROCESS HEAT/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR RADIATION/ATTENUATION
Theoretical simulation of solar spectra in the middle ultraviolet and visible for atmospheric trace constituent measurements. Final report, 15 March 1977-15 April 1978, 4:39547 (N-78-27687)
SOLAR RADIATION/GAMMA SPECTRA
Solar gamma rays above 8 MeV, 4:39751 (N-78-32031)
SOLAR RADIOWAVE RADIATION/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR RADIOWAVE RADIATION/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
SOLAR SPACE HEATING/BIBLIOGRAPHIES
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Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports, 4:38349 (NTISUB/D-450)
SOLAR SPACE HEATING/REVIEWS
Design concepts for solar heating in a Mediterranean climate, 4:38461 (CONF-7709179-1)
SOLAR SPACE HEATING/SOCIAL IMPACT
Social assessment of on-site solar energy technologies. Topical report, 4:38366 (HCP/R4040-02)
SOLAR SYSTEM EVOLUTION/BIBLIOGRAPHIES
A bibliography of planetary geology principal investigators and their associates, 1976-1978, 4:39756 (N-78-28027)
SOLAR THERMAL POWER PLANTS/BIBLIOGRAPHIES
Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports, 4:38349 (NTISUB/D-450)
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
SOLAR THERMAL POWER PLANTS/CHEMICAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
SOLAR THERMAL POWER PLANTS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
SOLAR THERMAL POWER PLANTS/SITE SELECTION
Siting issues for solar thermal power plants with small community applications, 4:38406 (N-78-30663)
SOLAR TRACKING/CONTROL SYSTEMS
Solar tracking control system Sun Chaser, 4:38491 (DOE/NASA/TM-78225)
SOLAR WATER HEATERS/DESIGN
Solar heating and cooling system design and development. Status summary through December 1977, 4:38472 (N-78-28613)
System design package for solar heating and cooling system installed at Akron, Ohio, 4:38464 (DOE/NASA/CR-161192)
SOLAR WATER HEATERS/DRAIN-DOWN SYSTEMS
Solar heater freeze protection system (Patent), 4:38483
SOLAR WATER HEATERS/FREEZE PROTECTION
Solar heater freeze protection system (Patent), 4:38483
SOLAR WATER HEATING/BIBLIOGRAPHIES
Solar thermal power generation, 1978; solar thermal heating and cooling, 1978; solar thermal components, 1978. Quarterly reports, 4:38349 (NTISUB/D-450)
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
SOLAR WATER PUMPS/BIBLIOGRAPHIES
Solar thermal components, 1978. Quarterly reports, 4:38351 (NTISUB/D-453)
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR WIND/KINETICS
A theory of local and global processes which affect solar wind electrons. 1: The origin of typical 1 AU velocity distribution functions: steady-state theory, 4:39750 (N-78-31033)
SOLAR WIND/MATHEMATICAL MODELS
A three-dimensional model of corotating streams in the solar wind. 1: theoretical foundations, 4:39744 (N-78-28031)
SOLAR WIND/PROTON TEMPERATURE
Pioneer 10 observation of the solar wind proton temperature heliocentric gradient, 4:39748 (N-78-31030)
SOLAR WIND/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR X-RAY BURSTS/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SOLAR-ASSISTED HEAT PUMPS/BIBLIOGRAPHIES
Solar thermal components: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38414 (TAC-STC-78-003)
SOLAR-ASSISTED HEAT PUMPS/EVALUATION
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SOLAR-ASSISTED POWER SYSTEMS/DESIGN
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SOL-GEL PROCESS/RESEARCH PROGRAMS
Sol-gel sphere-pac activities for the fuel refabrication and development program. Quarterly progress report for period ending December 31, 1977, 4:38227 (ORNL/TM-6746)
SOLID SOLUTIONS/CUBIC LATTICES
Drift mobility correlation in a simple cubic lattice, 4:39105
SOLID STATE PHYSICS/MEETINGS
Physics of semiconductors, 1978, 4:39950
SOLID WASTES
See also AGRICULTURAL WASTES
WOOD WASTES
SOLID WASTES/ENVIRONMENTAL EFFECTS
Burial ground technology, 4:39603 (ORNL-5508)
SOLID WASTES/LEACHING
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
SOLID WASTES/MATHEMATICAL MODELS
Earth Sciences, 4:38087 (ORNL-5508)
SOLID WASTES/WASTE DISPOSAL
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
Effects of the disposal of coal waste and ashes in open pits. Final report, 4:39616 (PB-284013)
SOLIDS/BAND THEORY
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)

SOLIDS/ELECTRONIC STRUCTURE
Quasi-classical approximation of electron spectra of compressed solids, 4:39948 (UCRL-Trans-11471)
SOLITONS/DAMPING
Damped double solitons in the nonlinear Schroedinger equation, 4:39998
SOLITONS/SCHROEDINGER EQUATION
Damped double solitons in the nonlinear Schroedinger equation, 4:39998
SOLVENT-REFINING COAL PLANTS
See COAL PREPARATION PLANTS
SOLVENTS
See also ORGANIC SOLVENTS
SOLVENTS/TESTING
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
SOUTH CAROLINA/NUCLEAR FACILITIES
Nuclear facility monitoring in South Carolina, 4:39604 (PB-283837)
SOUTH CAROLINA/RADIATION MONITORING
Nuclear facility monitoring in South Carolina, 4:39604 (PB-283837)
SOUTH DAKOTA/ENERGY SUPPLIES
Midwestern energy supply issues: a survey of state views, 4:38909 (ANL/EES-TM-40)
SOVIET UNION
See USSR
SPACE POWER REACTORS
Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission), 4:38788
SPACE PROPULSION REACTORS
Laswers from fission (gaseous core reactors and nuclear pumped lasers for space power generation and transmission), 4:38788
SPACE VEHICLES/ELECTRIC BATTERIES
Battery literature search, bibliography and abstracts. Volume II, 4:38841 (N-77-74766)
Battery literature search, bibliography and abstracts. Volume V, 4:38842 (N-77-74769)
SPACE VEHICLES/ELECTRONIC EQUIPMENT
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SPACE VEHICLES/NICKEL-CADMIUM BATTERIES
Battery literature, search, bibliography and abstracts. Volume I, 4:38840 (N-77-74765)
SPACECRAFT POWER SUPPLIES/NICKEL-CADMIUM BATTERIES
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
SPACECRAFT POWER SUPPLIES/SILVER-CADMIUM BATTERIES
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
SPACECRAFT POWER SUPPLIES/SILVER-ZINC BATTERIES
Evaluation program for secondary spacecraft cells. Annual report, 4:38846 (N-78-31540)
SPACECRAFT POWER SUPPLIES/SOLAR CELL ARRAYS
High-power, ultralow-mass solar arrays: FY-77 solar arrays technology readiness assessment report, Volume 1, 4:38378 (N-78-27530)
Plan for flight evaluation of attitude stabilization and flexible solar array dynamics for the Communications Technology Satellite, 4:38396
Thermal vacuum life test of an MSDS solar array drive (MSDS No. 2). First 2 years of operation, 4:38382 (N-78-28475)
SPARK IGNITION ENGINES/DESIGN
Turbocharged engine with vacuum bleed valve (Patent), 4:39070
SPARK IGNITION ENGINES/EXHAUST GASES
Emissions and fuel economy testing of a Naval Academy heat balanced engine (NAHBE), 4:39064 (PB-285382)
SPARK IGNITION ENGINES/FUEL ECONOMY
Emissions and fuel economy testing of a Naval Academy heat balanced engine (NAHBE), 4:39064 (PB-285382)
SPECTRAL FUNCTIONS/STATISTICS
Spectral variance estimation and the analysis of turbulence data, 4:39983
SPECTRALLY SELECTIVE SURFACES/CHEMICAL VAPOR DEPOSITION
Chemical vapor deposition of spectrally selective surfaces for high-temperature photothermal conversion, 4:38393
SPECTROMETERS
See also GAMMA SPECTROMETERS
MAGNETIC SPECTROMETERS
MULTIPARTICLE SPECTROMETERS
X-RAY SPECTROMETERS
SPECTROMETERS/AIR POLLUTION MONITORS
Remote sensing of atmospheric pollution from space, 4:39549 (N-78-30725)
SPECTROMETERS/SENSITIVITY
Noise considerations in millimeter-wave spectrometers, 4:39494 (LBL-7294)
SPENT FUEL CASKS/ACCIDENTS
Environmental impact of accidents involving radioactive material shipping systems, 4:39279 (SAND-78-1584C)
SPENT FUEL CASKS/RAIL TRANSPORT
Dynamic analysis to establish normal shock and vibration of radioactive material shippng packages. Quarterly progress report, July-September 1978, 4:39277 (NUREG/CR-0589)
SPENT FUEL STORAGE/EVALUATION
Spent unreprocessed fuel (SURF) facility evaluation plan of the alternative storage concepts, 4:38247 (RHO-CD-271)
SPENT FUEL STORAGE/STORAGE FACILITIES
Design and operation of a dry spent fuel storage installation, 4:38262 (CONF-790602-25)
SPENT FUELS/NONDESTRUCTIVE ANALYSIS
Passive neutron assay of irradiated nuclear fuels, 4:38239 (LA-7645-MS)
SPENT FUELS/REPROCESSING
Pyrochemical coprocessing of UO_2-PuO_2 LMFBR fuel by the Salt Transport Method, 4:38242 (RFP-2887)
SPENT FUELS/TRANSPORT
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL-2457)
SPENT SHALES/HYDRAULIC TRANSPORT
The hydraulic transportation of oil shale. Research report, 4:38186 (PB-283817)
SPERMATOZOA/BIOLOGICAL RADIATION EFFECTS
Monitoring environmental exposures with semen assays (Mice), 4:39669 (UCRL-52000-79-3)
SPRAY PONDS
See COOLING PONDS
SPREAD F/CYCLOTRON INSTABILITY
High frequency drift waves with wavelengths below the ion gyroradius in equatorial spread F. Interim report, 4:39761 (AD-A-058246)
SPREAD F/DRIFT INSTABILITY
High frequency drift waves with wavelengths below the ion gyroradius in equatorial spread F. Interim report, 4:39761 (AD-A-058246)
SPUTTERING/COMPUTER CALCULATIONS
Sputtering calculations with the discrete-ordinates method, 4:39781
SPUTTERING/DISCRETE ORDINATE METHOD
Sputtering calculations with the discrete-ordinates method, 4:39781
SRC PROCESS/RESIDUES
Solvent refined coal (SRC) process. Research and development report No. 53. Interim report No. 23, 1976-1977. Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 11. Processing of solvent refined coal minerals, 4:38073 (FE-0496-T14)
STACK DISPOSAL
Determination of the physico-chemical species of radioiodine in the stack discharge of nuclear power plants, 4:38762 (KFK-EXT-30/78-1)
STAINLESS STEEL-304/CRACKS
Crack initiation and growth in welds at 1100°F (593°C), 4:39120 (INIS-mf-4506)
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
STAINLESS STEEL-304/DEGASSING
Performance of vacuum components operating at 1×10^{-11} Torr, 4:39486
STAINLESS STEEL-304/FATIGUE
Reactor safety research programs. Quarterly progress report, July 1-September 30, 1978, 4:38812 (NUREG/CR-0513)
STAINLESS STEEL-304/PHYSICAL RADIATION EFFECTS
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL-25733)
STAINLESS STEEL-304/SORPTIVE PROPERTIES
Ion and electron desorption of neutral molecules from stainless steel (304), 4:40025
STAINLESS STEEL-304/STRESS CORROSION
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel

and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
STAINLESS STEEL-304L/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
STAINLESS STEEL-308/CRACKS
Crack initiation and growth in welds at 1100°F (593°C), 4:39120 (INIS-mf-4506)
STAINLESS STEEL-310/CORROSION
Evaluation of high chromium overlays to protect less alloyed substrates from corrosion in a coal gasification atmosphere. Quarterly report, March 1-May 31, 1978, 4:38061 (FE-2621-3)
STAINLESS STEEL-310/MATERIALS TESTING
Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Semi-annual progress report, 4:38068 (TID-29304)
STAINLESS STEEL-316/CORROSION
Electrode polarization studies in hot corrosion systems. Progress report, 1 July 1978-31 May 1979, 4:39091 (COO-2960-3)
STAINLESS STEEL-316/CRACKS
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
STAINLESS STEEL-316/DEGASSING
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
STAINLESS STEEL-316/FERRITES
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
STAINLESS STEEL-316/MICROSTRUCTURE
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
STAINLESS STEEL-316/NONDESTRUCTIVE TESTING
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
STAINLESS STEEL-316/PHYSICAL RADIATION EFFECTS
Analysis of various NDT techniques to determine their feasibility for detecting thin layers of ferrite on Type 316 stainless steel, 4:39167 (PNL-2805)
STAINLESS STEEL-316/TENSILE PROPERTIES
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
STAINLESS STEEL-316/VACANCIES
Nondestructive examination of deformed steel and nickel by positron annihilation, 4:39128 (SAND-79-0636C)
STAINLESS STEEL-316/WELDED JOINTS
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
STAINLESS STEELS
STAINLESS STEEL-304
See also STAINLESS STEEL-304L
STAINLESS STEEL-308
STAINLESS STEEL-310
STAINLESS STEEL-316
STAINLESS STEELS/MATERIALS TESTING
Qualification of stainless steel for OTEC heat exchanger tubes, 4:38410 (ANL/OTEC-001)
STAINLESS STEELS/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
STANDING CROP
See BIOMASS
STAR MODELS/STAR EVOLUTION
Evolution and explosion of massive stars (Hydrodynamics, convection), 4:39736 (UCRL-82057(Rev.1))
STARS
See also BINARY STARS
CEPHEIDS
MAIN SEQUENCE STARS
NEUTRON STARS
SUN
SUPERNOVAE
STARS/CHEMICAL COMPOSITION
An investigation of the far ultraviolet spectra of the pole-on Be stare mu Cen and upsilon Cyg. Final technical report, 4:39735 (N-78-31018)
STARS/INFRARED SPECTRA
The potential for astrometry in the infrared (γ Orionis), 4:39734 (N-78-31017)
STARS/ULTRAVIOLET SPECTRA
An investigation of the far ultraviolet spectra of the pole-on Be stare mu Cen and upsilon Cyg. Final technical report, 4:39735 (N-78-31018)
STATIC RESERVOIR PRESSURE
See RESERVOIR PRESSURE
STATIONARY POLLUTANT SOURCES
(Used for general articles when sources are not named. See also specific stationary sources, e.g., Fossil-fuel Power Plants.)
See also AIR POLLUTION
STATIONARY POLLUTANT SOURCES/CHEMICAL EFFLUENTS
Emission characterization of stationary NOx sources. Volume II. Data supplement. Special report (Abatement and control technologies to meet projected NO/sub x/ air quality standards to the year 2000.), 4:39565 (PB-285429)
STATISTICAL MODELS/THERMODYNAMIC PROPERTIES
Quantum-statistical model for high-density matter, 4:39155
STATISTICS
Bivariate distributions with given marginals and fixed measures of dependence, 4:40038 (LA-7700-MS)
Statistics for simplification, 4:40040 (MHSMP-79-42)
STATISTICS/ALGORITHMS
New algorithm for summing divergent series. Part 3. Applications, 4:40047
STATISTICS/CALCULATION METHODS
Multiple-comparisons procedures. Informal report, 4:40037 (LA-7677-MS)
STEAM GENERATING HEAVY WATER REACTOR
See SGHWR REACTOR
STEAM GENERATORS/CONSTRUCTION
U-type steam generators for nuclear power plants and their manufacture, 4:38630 (AED-Conf-78-155-006)
STEAM GENERATORS/FLUID FLOW
Workshop proceedings: flow-induced vibrations, 4:38736 (EPRI-WS-78-125)
STEAM GENERATORS/MECHANICAL VIBRATIONS
Workshop proceedings: flow-induced vibrations, 4:38736 (EPRI-WS-78-125)
STEAM GENERATORS/PERFORMANCE
Chemical control and design considerations for CANDU-PHW steam generators, 4:38647
STEAM INJECTION/RESEARCH PROGRAMS
DEEP STEAM Project 16 enhanced oil recovery. Quarterly report, October 1-December 31, 1978, 4:38145 (SAND-79-0562)
STEAM SYSTEMS/RADIOACTIVITY TRANSPORT
Growth of radiation fields around CANDU boilers, 4:38652
STEEL-ASTM-A106/CLEANING
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
STEEL-ASTM-A302/CLEANING
Dresden 1 Radiation Level Reduction Program. Intergranular corrosion tests of sensitized Type-304 stainless steel in Dow NS-1, and stress corrosion cracking tests of Type-304 stainless steel and carbon and low alloy steels in Dow copper rinse solution, 4:38626 (NEDC-24143)
STEEL-ASTM-A508/CRACKS
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
STEEL-ASTM-A508/FRACTURE PROPERTIES
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf-4506)
STEEL-ASTM-A508/RESIDUAL STRESSES
Estimation of residual stresses in reactor pressure vessel steel specimens clad by stainless steel strip electrodes, 4:39132
Measurement of residual stresses in claddings, 4:39131
STEEL-ASTM-A533/CRACKS
Fracture mechanics practice for crack arrest, 4:39115 (INIS-mf-4506)
Methodology for plastic fracture. A progress report, 4:39126 (INIS-mf-4506)
Some mechanistic observations on the crack growth characteristics of pressure vessel and piping steels in PWR environment, 4:38631 (CONF-790313-4)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)
STEEL-ASTM-A533/FRACTURE PROPERTIES
Fracture mechanics practice for crack arrest, 4:39115 (INIS-mf-4506)
Heavy-section steel technology program intermediate-scale pressure vessel tests, 4:38806 (INIS-mf-4506)
Methodology for plastic fracture. A progress report, 4:39126 (INIS-mf-4506)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)

STEELS
See also CARBON STEELS
CHROMIUM STEELS
CHROMIUM-NICKEL STEELS
STAINLESS STEELS
STEEL-ASTM-A302
STEEL-ASTM-A533
STEELS/CRACKS
Analysis of cracks by means of FEM, 4:39121 (INIS-mf-4506)
Application of the J-integral concept to cracks emanating from a hole, 4:39111 (INIS-mf-4506)
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
Assessment of the integrity of PWR pressure vessels. A U.K. study group report, 4:38805 (INIS-mf-4506)
Cracked element approach for the computation of stress intensity factors, 4:39125 (INIS-mf-4506)
Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures, 4:39118 (INIS-mf-4506)
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf-4506)
Finite element elastic-plastic analysis of initiation and stable crack growth in three-point bending, 4:39113 (INIS-mf-4506)
Geometric influences upon stress intensity distributions along reactor vessel nozzle cracks, 4:39124 (INIS-mf-4506)
Improved stress-intensity factors for semi-elliptical surface cracks in finite-thickness plates, 4:39109 (INIS-mf-4506)
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
Influence of transverse shear on plasticity around an axial crack in a cylindrical shell, 4:39108 (INIS-mf-4506)
Interpretaion of the instrumented Charpy test, 4:39116 (INIS-mf-4506)
Method of line applied to 3-D crack problems including plasticity effect, 4:39114 (INIS-mf-4506)
Outer and inner surface flaws in thick-walled pressure vessels, 4:39112 (INIS-mf-4506)
Pressure vessel fracture safety investigations using as criterion the onset of crack propagation, 4:39122 (INIS-mf-4506)
Some comments about the J_1 integral criterion in post yield fracture mechanics, 4:39110 (INIS-mf-4506)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)
Stress intensity factors of corner cracks in two nozzle-cylinder intersections, 4:39117 (INIS-mf-4506)
Two- and three-dimensional finite element analysis of a central cracked crackgrowth test specimen, 4:38740 (INIS-mf-4506)
STEELS/FRACTURE PROPERTIES
Advances in fracture mechanics analyses of primary system performance under operating and accident conditions, 4:39119 (INIS-mf-4506)
Analysis of cracks by means of FEM, 4:39121 (INIS-mf-4506)
Application of the J-integral concept to cracks emanating from a hole, 4:39111 (INIS-mf-4506)
Assessment of cracks for elasto-plastic material behavior, 4:38969 (INIS-mf-4506)
Cracked element approach for the computation of stress intensity factors, 4:39125 (INIS-mf-4506)
Effects of specimen and vessels size on toughness measurements and crack propagation in ductile structures, 4:39118 (INIS-mf-4506)
Effects of location, thermal stress, and residual stress on corner cracks in nozzles with cladding, 4:38625 (INIS-mf-4506)
Enhancement of the quality of the reactor pressure vessel used in light water power plants by advanced material fabrication and testing technologies, 4:39127 (INIS-mf-4506)
Finite element elastic-plastic analysis of initiation and stable crack growth in three-point bending, 4:39113 (INIS-mf-4506)
Improved stress-intensity factors for semi-elliptical surface cracks in finite-thickness plates, 4:39109 (INIS-mf-4506)
Influence of transverse shear on plasticity around an axial crack in a cylindrical shell, 4:39108 (INIS-mf-4506)
Method of line applied to 3-D crack problems including plasticity effect, 4:39114 (INIS-mf-4506)
Nuclear pressure boundary materials research, problems and proposed solutions, 4:39161 (INIS-mf-4506)
Outer and inner surface flaws in thick-walled pressure vessels, 4:39112 (INIS-mf-4506)
Pressure vessel fracture safety investigations using as criterion the onset of crack propagation, 4:39122 (INIS-mf-4506)
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)
Some comments about the J_1 integral criterion in post yield fracture mechanics, 4:39110 (INIS-mf-4506)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)
Two- and three-dimensional finite element analysis of a central cracked crackgrowth test specimen, 4:38740 (INIS-mf-4506)
STEELS/OXIDATION
Oxide thickness monitor, 4:39506 (N-78-28429)
STEELS/PHYSICAL RADIATION EFFECTS
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)
STEELS/PLASTICITY
Influence of transverse shear on plasticity around an axial crack in a cylindrical shell, 4:39108 (INIS-mf-4506)
STEELS/STRESS ANALYSIS
Influence of the stress state on Ksub(Ic), 4:39107 (INIS-mf-4506)
STELLARATORS/EQUILIBRIUM PLASMA
Equilibria of diffuse high beta stellarators, 4:39967
STELLARATORS/HIGH-BETA PLASMA
Equilibria of diffuse high beta stellarators, 4:39967
STEM CELLS/DELAYED RADIATION EFFECTS
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL-25730)
STIRLING ENGINES/COMBUSTORS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
STIRLING ENGINES/FUEL ECONOMY
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
STIRLING ENGINES/TECHNOLOGY ASSESSMENT
Automotive technology status and projections. Volume 2. Assessment report, 4:39063 (N-78-31429)
STOCHASTIC PROCESSES
Stochastic cooling theory and devices, 4:39410 (LBL-7574)
STOCHASTIC PROCESSES/BEAM DYNAMICS
Stochastic cooling with noise and good mixing, 4:39417 (LBL-7574)
STOCHASTIC PROCESSES/EQUATIONS
Overview of beam cooling, 4:39409 (LBL-7574)
Stochastic cooling theory, 4:39412 (LBL-7574)
STOCHASTIC PROCESSES/MATHEMATICAL MODELS
Stochastic cooling with noise and good mixing, 4:39417 (LBL-7574)
STORAGE DEVICES (DATA)
See MEMORY DEVICES
STORAGE FACILITIES
See also NATURAL GAS
PETROLEUM
STORAGE FACILITIES/DESIGN
Design and operation of a dry spent fuel storage installation, 4:38262 (CONF-790602-25)
STORAGE FACILITIES/OPERATION
Design and operation of a dry spent fuel storage installation, 4:38262 (CONF-790602-25)
STORAGE RINGS
See also ISABELLE STORAGE RINGS
PEP STORAGE RINGS
PETRA STORAGE RING
STORAGE RINGS/BEAM DYNAMICS
Are we beating Liouville's theorem, 4:39415 (LBL-7574)
STORAGE RINGS/BEAM LUMINOSITY
High luminosity anti pp machines: the physics goals, 4:39477 (LBL-7574)
STORAGE RINGS/BEAM OPTICS
Chromatic corrections for large storage rings, 4:39485 (SLAC-PUB-2270)
STORAGE RINGS/COLLIDING BEAMS
Proceedings of the workshop on producing high luminosity high energy proton-anti proton collisions, 4:39475 (LBL-7574)
STORAGE RINGS/FREE ELECTRON LASERS
Free electron laser and its possible developments, 4:39474 (BNL-25857)
STORAGE RINGS/MEETINGS
Proceedings of the workshop on producing high luminosity high energy proton-anti proton collisions, 4:39475 (LBL-7574)
STORAGE RINGS/NEUTRAL ATOM BEAM INJECTION
Neutral beam injection for a proton storage ring, 4:39432 (LA-UR-79-703)
STORAGE RINGS/PULSE SHAPERS
Properties of a linac-storage ring stretcher system, 4:39482 (SLAC-PUB-2262)
STORAGE RINGS/SYNCHROTRON RADIATION
Free electron laser and its possible developments, 4:39474 (BNL-25857)
STORAGE RINGS/VACUUM SYSTEMS
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL-25733)
STORAGE RINGS/WIGGLER MAGNETS
Modeling a horizontal wiggler in an electron storage ring, 4:39480 (SLAC-PUB-2255)
STORAGE (SPENT FUEL)
See SPENT FUEL STORAGE

STOVES/DESIGN
Wood burning stove with forced air heating (Patent), 4:38994
STRATIFIED CHARGE ENGINES/FUEL-AIR RATIO
Influence of overall fuel-air ratio and degree of stratification on the fuel consumption and emissions of a prechamber, stratified-charge engine, 4:39071
STRATOSPHERE/AEROSOLS
One-dimensional model of the stratospheric aerosol, 4:39577
Structure, composition and distribution of stratospheric aerosol particles and their radiative properties and importance for the radiation budget, 4:39576
STRATOSPHERE/HUMIDITY
Stratospheric H_2O, 4:39533 (UCRL-82542)
STRATOSPHERE/OZONE
Results of research related to stratospheric ozone protection. Report to congress, 4:39554 (PB-284400)
STREAMS
See also RIVERS
STREAMS/ECOLOGY
Ecosystem Studies Program, 4:39615 (ORNL-5508)
STREAMS/WATER POLLUTION
Aqueous studies of hydrogen sulfide releases from a heavy water extraction facility, 4:39613 (DP-1512)
STRIPED BASS/GROWTH
Cooling Systems Program, 4:39621 (ORNL-5508)
STRIPED BASS/HEAT TRANSFER
Cooling Systems Program, 4:39621 (ORNL-5508)
STRIPED BASS/TEMPERATURE EFFECTS
Cooling Systems Program, 4:39621 (ORNL-5508)
STRONG INTERACTIONS
See also HADRON-HADRON INTERACTIONS
STRONG INTERACTIONS/PARTICLE PRODUCTION
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
STRONG INTERACTIONS/QUANTUM CHROMODYNAMICS
Expectations for ultra-high energy interactions, 4:39855 (LBL-7574)
STRONG-COUPLING MODEL/MASS FORMULAE
Lattice-gauge-theory spectrum for broken SU(4), 4:39837
STRONTIUM/FLUORESCENCE
Laser induced fluorescence studies of the reactions of barium (^1S, ^3D) and strontium (^1S, ^3P) with halogenated methanes, 4:39251
STRONTIUM/PHOTOCHEMICAL REACTIONS
Laser induced fluorescence studies of the reactions of barium (^1S, ^3D) and strontium (^1S, ^3P) with halogenated methanes, 4:39251
STRONTIUM 89/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
STRONTIUM 90/ENVIRONMENTAL EFFECTS
Burial ground technology, 4:39603 (ORNL-5508)
STRONTIUM 90/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
STRONTIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
STRONTIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
STRONTIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
STRUCTURE (CRYSTAL)
See CRYSTAL STRUCTURE
STUDS
See FASTENERS
STYRENE POLYMERS
See POLYSTYRENE
SU-4 GROUPS/SYMMETRY BREAKING
Lattice-gauge-theory spectrum for broken SU(4), 4:39837
SUDDEN IONOSPHERIC DISTURBANCE/SOLAR ALPHA PARTICLES
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
SULFATES/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
SULFATES/ECOLOGICAL CONCENTRATION
Tropospheric aerosols, 4:39535
SULFATES/ENVIRONMENTAL EFFECTS
Dominance of tropospheric sulfate in modifying solar radiation, 4:39536
SULFATES/ENVIRONMENTAL TRANSPORT
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
Comparison of particulate and gaseous material within and above the mixed layer, 4:39540 (BNL-25002)
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
SULFATES/MONITORING
Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976-February 1977, 4:39563 (PB-285059)
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
SULFHYDRYL COMPOUNDS
See THIOLS
SULFIDES/AGING
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SULFIDES/COMPATIBILITY
Design of an aging and compatibility test for materials in the MC-2802 fireset, 4:39191 (SAND-78-1198)
SULFITES/BIOLOGICAL EFFECTS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
SULFUR/AEROSOL MONITORING
Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL-7999)
SULFUR/CHEMICAL STATE
Surface characterization of methanation catalysts by x-ray photoelectron spectroscopy, 4:39222 (LBL-8975)
SULFUR/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SULFUR/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
SULFUR/MARKET
Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974-June 1977, 4:39045 (PB-284200)
SULFUR/REMOVAL
Advanced development of fine coal desulfurization and recovery technology. Annual technical progress report, October 1, 1977-September 30, 1978, 4:38044 (IS-4668)
SULFUR/X-RAY FLUORESCENCE ANALYSIS
Automatic particulate sulfur monitor using a dichotomous sampler and x-ray fluorescence analysis, 4:39545 (LBL-7999)
SULFUR/X-RAY SPECTROSCOPY
Application of x-ray emission spectra to the identification of particulate sulfur compounds in ambient air, 4:39544 (LBL-7284)
SULFUR CARBIDES
See CARBON SULFIDES
SULFUR DIOXIDE/ADSORPTION
Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977-November 30, 1978, 4:39551 (ORO-5592-2)
SULFUR DIOXIDE/AIR POLLUTION ABATEMENT
Review of new source performance standards for coal-fired utility boilers. Volume I. Emissions and non-air quality environmental impacts, 4:38605 (PB-285854)
SULFUR DIOXIDE/AIR POLLUTION CONTROL
Flue gas desulfurization system capabilities for coal-fired steam generators. Volume I. Executive summary. Final task report, April-December 1977, 4:38602 (PB-284045)
Process for removing sulfur dioxide from waste gases (Patent), 4:38607
SULFUR DIOXIDE/ATMOSPHERIC PRECIPITATIONS
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
SULFUR DIOXIDE/ENVIRONMENTAL TRANSPORT
Assessment of national consequences of increased coal utilization. Executive summary, 4:38094 (TID-29425(Vol.1))
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
Comparison of particulate and gaseous material within and above the mixed layer, 4:39540 (BNL-25002)
Diagnostic atmospheric cross-section experiment (DACSE-1) of MAP3s: 1-10 August 1977. Part 1. Atmospheric cross-section analyses. Part II. Regional transport of pollutants (Profiles

obtained along northern edge of Ohio River Valley), 4:39539 (ANL/RER-78-2)
SULFUR DIOXIDE/GAS CHROMATOGRAPHY
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
SULFUR DIOXIDE/INVENTORIES
Area source emission inventory for York County, South Carolina. Final report, 4:39569 (PB-286229)
SULFUR DIOXIDE/MONITORING
An experimental/analytical program to assess the utility of lidar for pollution monitoring. Final report, 1 September 1976-31 October 1977, 4:39546 (N-78-27614)
Biogenic sulfur compounds in coastal atmospheres of North Carolina. Final report, August 1976-February 1977, 4:39563 (PB-285059)
SULFUR DIOXIDE/QUANTITATIVE CHEMICAL ANALYSIS
Electrochemical apparatus for analyzing carbon monoxide,hydrogen sulfide, hydrogen and sulfur dioxide, 4:39208 (BMFT-FB-T-78-08)
SULFUR DIOXIDE/REMOVAL
Process for pressure stripping of sulfur dioxide from buffered solutions (Patent), 4:39357
SULFUR FLUORIDES/CHARGED-PARTICLE TRANSPORT
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
SULFUR FLUORIDES/DIELECTRIC PROPERTIES
Fundamental techniques for gas-insulated apparatus, 4:38618
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA-7445-C)
SULFUR HYDRIDES
See HYDROGEN SULFIDES
SULFUR OXIDES/AIR POLLUTION CONTROL
Carbonaceous fuel combustion with improved desulfurization (Patent), 4:38608
Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974-June 1977, 4:39045 (PB-284200)
SULFUR OXIDES/BIOLOGICAL EFFECTS
Environmental effects of increased coal utilization ecological effects of gaseous emissions from coal combustion. Final report, 4:39693 (PB-285440)
SULFUR OXIDES/ENVIRONMENTAL TRANSPORT
General considerations on how rainwater must obtain sulfate nitrate and acid, 4:39612 (BNL-25114)
SULFURIC ACID/AEROSOL MONITORING
Determination of ambient H_2SO_4 and it's ammonium salts by in situ aerosol thermal analysis, 4:39574
SULFURIC ACID/MARKET
Potential abatement production and marketing of byproduct sulfuric acid in the U.S. Final report, July 1974-June 1977, 4:39045 (PB-284200)
SUN/MAGNETIC FIELDS
A physical mechanism for the prediction of the sunspot number during solar cycle 21, 4:39746 (N-78-29028)
Solar-geophysical data number 406, June 1978, Part I. (prompt reports). Data for May 1978, April 1978, 4:39752 (PB-285773)
The strength of the sun's polar fields, 4:39747 (N-78-29029)
SUN/TABLES
Solar-geophysical data number 406, June 1978. Part II. (Comprehensive reports). Data for December 1977 - november 1977 and miscellanea, 4:39753 (PB-285774)
SUNSHINE PROJECT/GEOTHERMAL POWER PLANTS
Geothermal energy technology, 4:38544
SUNSPOTS/FORECASTING
A physical mechanism for the prediction of the sunspot number during solar cycle 21, 4:39746 (N-78-29028)
SUPER HIGH FREQUENCY RADIATION
See RADIOWAVE RADIATION
SUPERCHARGERS/DESIGN
Turbocharger lubrication and exhaust system (Patent), 4:39059
SUPERCONDUCTING CABLES/DIELECTRIC MATERIALS
DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977-September 30, 1978, 4:38622 (LA-7707-PR)
SUPERCONDUCTING CABLES/ENERGY LOSSES
Energy losses in a flat transposed cable, 4:38621 (LA-7635-MS)
SUPERCONDUCTING CABLES/RESEARCH PROGRAMS
DC Superconducting Power Transmission Line Project at LASL: US DOE Division of Electric Energy Systems, Progress report No. 23, October 1, 1977-September 30, 1978, 4:38622 (LA-7707-PR)
SUPERCONDUCTING COILS/ENERGY LOSSES
Energy losses in a flat transposed cable, 4:38621 (LA-7635-MS)
SUPERCONDUCTING COILS/ENERGY TRANSFER
Square function analysis of the Inductor-Converter Bridge, 4:39268 (ANL/FPP/TM-118)
SUPERCONDUCTING DEVICES
See also SUPERCONDUCTING GENERATORS
SUPERCONDUCTING MAGNETS
SUPERCONDUCTING MOTORS
SUPERCONDUCTING WIRES
SUPERCONDUCTING DEVICES/BIBLIOGRAPHIES
Superconducting devices and materials. A literature survey issued quarterly, October-December 1978, 4:39955 (NBS-78-04)
SUPERCONDUCTING GENERATORS/DESIGN
Superconductive winding for an iron core rotor of a dynamoelectric machine (Patent), 4:39272
SUPERCONDUCTING GENERATORS/PERFORMANCE
Superconducting disc alternator, 4:39271 (N-78-28354)
SUPERCONDUCTING GENERATORS/SPECIFICATIONS
Superconducting disc alternator, 4:39271 (N-78-28354)
SUPERCONDUCTING MAGNETS/DESIGN
Superconducting magnetohydrodynamic magnet development program, Phase I. Quarterly technical progress report No. 6, October 1-December 31, 1977, 4:38970 (MIT-2295-1)
SUPERCONDUCTING MAGNETS/EQUIPMENT PROTECTION DEVICES
Method and device for monitoring superconducting system (Patent), 4:39273
SUPERCONDUCTING MAGNETS/FLUCTUATIONS
Observation of voltage fluctuations in a superconducting magnet during MHD power generation, 4:38958 (CONF-780952-24)
SUPERCONDUCTING MAGNETS/SUPPORTS
Design analysis of annular tunnels for superconductive energy storage using the finite element method, 4:38832
ISABELLE magnet support and adjustment system, 4:39472 (BNL-25799)
SUPERCONDUCTING MOTORS/DESIGN
Superconductive winding for an iron core rotor of a dynamoelectric machine (Patent), 4:39272
SUPERCONDUCTING WIRES/ENERGY LOSSES
Losses in superconducting multifilament composites under alternating changing fields, 4:39270 (LA-7639-MS)
SUPERCONDUCTING WIRES/FABRICATION
Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976-September 30, 1977 (Nb_3Sn conductor testing), 4:39269 (BNL-50961)
SUPERCONDUCTING WIRES/MECHANICAL PROPERTIES
Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976-September 30, 1977 (Nb_3Sn conductor testing), 4:39269 (BNL-50961)
SUPERCONDUCTIVITY/BIBLIOGRAPHIES
Superconducting devices and materials. A literature survey issued quarterly, October-December 1978, 4:39955 (NBS-78-04)
SUPERCONDUCTORS/FERROMAGNETISM
Superconductivity and ferromagnetism, 4:39957
SUPERCRITICAL FLOW
See TURBULENT FLOW
SUPERHEAVY ELEMENTS
See TRANS 104 ELEMENTS
SUPERHILAC/MAGNETIC SPECTROMETERS
Precision magnetic measurements by the floating wire analog technique, 4:39458 (LBL-8818)
SUPERNOVAE/STAR EVOLUTION
Evolution and explosion of massive stars (Hydrodynamics, convection), 4:39736 (UCRL-82057(Rev.1))
SUPERNOVAE/STAR MODELS
Evolution and explosion of massive stars (Hydrodynamics, convection), 4:39736 (UCRL-82057(Rev.1))
SUPERTANKERS
See TANKER SHIPS
SURFACE AIR
See also AIR
EARTH ATMOSPHERE
SURFACE AIR/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SURFACE AIR/SAMPLING
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SURFACE COATING/NUCLEAR REACTION ANALYSIS
Analysis of coatings and thin films using energetic ions, 4:39177 (SAND-79-2076C)
SURFACE CONTAMINATION/METALLURGICAL EFFECTS
Role of surface contaminants in the deformation welding of gold to thick and thin films, 4:39093 (SAND-79-0352C)
SURFACE MINING
See also COAL MINING
OIL SHALE MINING

SURFACE MINING/LAND RECLAMATION
A benefit-cost system of decision making for strip mined land reclamation in Illinois, 4:38093 (PB-285447)
SURFACE WATERS
See also COASTAL WATERS
LAKES
RIVERS
STREAMS
SURFACE WATERS/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SURFACE WATERS/SAMPLING
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
SURFACE WATERS/WATER POLLUTION
Toxicological characteristics of shale waste waters, 4:39694 (DOE-tr-138)
SURFACE-ACTIVE AGENTS
See SURFACTANTS
SURFACTANTS
Tertiary oil recovery processes research at the University of Texas. Annual report, October 1977-September 1978, 4:38138 (BETC-0001-1)
SUSPENSIONS/HEAT TRANSFER
Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1978, 4:38055 (FE-2006-11)
SWIMMING POOLS/BIBLIOGRAPHIES
Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, July-September 1978, 4:38482 (TAC-STHC-78-003)
SWITCHES/DESIGN
Multiple application coded switch development report, 4:39260 (SAND-79-0329)
SWITCHES/ELECTRICAL INSULATION
Fundamental techniques for gas-insulated apparatus, 4:38618
SWITCHES/PERFORMANCE TESTING
Tests of vacuum interrupters for the Tokamak Fusion Test Reactor, 4:40009 (LA-7759-MS)
SYMPOSIA
See MEETINGS
SYNCHRONIZATION/RELATIVITY THEORY
Comment on a "New test of the synchronization procedure in noninertial systems", 4:39959
SYNCHROTRON RADIATION/MONOCHROMATORS
Separated function focusing monochromator system for synchrotron radiation, 4:39463
SYNTHESIS GAS/CHEMICAL COMPOSITION
Economics of gasoline production from underground coal gasification via Mobil-M process, 4:38047 (CONF-790405-12)
SYNTHESIS GAS/PRODUCTION
Processing of lignite for petrochemicals (Patent), 4:38069
SYNTHETIC FUELS
See also HYDROGEN FUELS
MOBIL M-GASOLINE PROCESS
SYNTHETIC FUELS/COMBUSTION PRODUCTS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
SYNTHETIC FUELS/COMBUSTION PROPERTIES
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
SYNTHETIC FUELS/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
SYNTHETIC FUELS/HEALTH HAZARDS
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415-31)
Synthetic Fuels Program, 4:38090 (ORNL-5508)
SYNTHETIC FUELS/PRODUCTION
Fusion reactors for synthetic fuels, 4:38301 (BNL-25634)
SYNTHETIC FUELS INDUSTRY/CHEMICAL EFFLUENTS
Synthetic fossil fuel technologies: health problems and intersociety cooperation, 4:38130 (CONF-790415-31)
SYNTHETIC PETROLEUM/COST
The relative costs of producing syncrude from oil shales of various grades under varying conditions, 4:38197 (N-78-31268)
SYSTEMS ANALYSIS/MATHEMATICAL MODELS
Descriptor variable representation of large-scale deterministic systems, 4:38864 (TID-29389)
SYSTEMS ANALYSIS/RESEARCH PROGRAMS
Descriptor variable representation of large-scale deterministic systems, 4:38864 (TID-29389)

T

TABLES
MAP3S Precipitation Chemistry Network: second periodic summary report, July 1977-June 1978, 4:39572 (PNL-2829)
TABLES/COMPUTER GRAPHICS
EASYTBL: phototypeset tables for LASL reports, 4:40036 (LA-7633-M)
TADPOLES
See LARVAE
TAKINOUE GEOTHERMAL FIELD/GEOTHERMAL POWER PLANTS
Kakkonda Geothermal Power Plant, 4:38533 (COO-4051-40)
TAKINOUE GEOTHERMAL FIELD/WELL DRILLING
Kakkonda Geothermal Power Plant, 4:38533 (COO-4051-40)
TANDEM ACCELERATORS
See VAN DE GRAAFF ACCELERATORS
TANKER SHIPS/ACCIDENTS
Offshore vessel traffic management (OVTM) study. volume i. executive summary. Final report Aug 77-Jun 78, 4:38172 (AD-A-059655)
TANTALUM/PHOTONUCLEAR REACTIONS
Photoneutron target design for fast neutron spectrum measurements, 4:39444 (COO-4933-1)
TANTALUM/SPUTTERING
H^+ and D^+ sputtering of thin tantalum films in the energy range of 0.6 to 15 keV, 4:39148
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
TANTALUM ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
TANTALUM IONS/ION-ATOM COLLISIONS
Theory of electron transfer and ionization, 4:39789 (CONF-790438-1)
TANTALUM OXIDES/SPUTTERING
Preferential sputtering of Ta_2O_5 by argon ions, 4:39776
TANTALUM OXIDES/SURFACE COATING
Analysis of coatings and thin films using energetic ions, 4:39177 (SAND-79-2076C)
TAR SANDS
See OIL SANDS
TARAPUR-1 REACTOR/RADIOACTIVE EFFLUENTS
Monitoring of radioactive waste discharges from Tarapur Atomic Power Station (TAPS), 4:38773
TARAPUR-2 REACTOR/RADIOACTIVE EFFLUENTS
Monitoring of radioactive waste discharges from Tarapur Atomic Power Station (TAPS), 4:38773
TARGETS
See also ION BEAM TARGETS
LASER TARGETS
TARGETS/DESIGN
Photoneutron target design for fast neutron spectrum measurements, 4:39444 (COO-4933-1)
TARGETS/RADIATIVE COOLING
Graphite targets for use in high intensity beams at LAMPF, 4:39450 (LA-UR-79-688)
TASMANIA/AGRICULTURE
An energy analysis of Tasmanian barley, hops and beer production, 4:39033 (PB-283950)
TASMANIA/ENERGY CONSUMPTION
Energy analysis: a Tasmanian application, 4:38862 (PB-283949)
TASMANIA/ENERGY SUPPLIES
Energy analysis: a Tasmanian application, 4:38862 (PB-283949)
TASMANIA/LAND TRANSPORT
The energy cost of road and rail transport in Tasmania, 4:39025 (PB-283952)
TASMANIA/METAL INDUSTRY
Energy analysis of zinc production, 4:39034 (PB-283951)
TASMANIA/RAIL TRANSPORT
The energy cost of road and rail transport in Tasmania, 4:39025 (PB-283952)
TAU PARTICLES/LEPTONIC DECAY
Anomalous e^+e^- and $\mu^+\mu^-$ events produced in e^+e^- annihilation (Differential cross sections), 4:39846
TAU PARTICLES/MASS
Anomalous e^+e^- and $\mu^+\mu^-$ events produced in e^+e^- annihilation (Differential cross sections), 4:39846
TEA
See BEVERAGES
TEARING INSTABILITY/NONLINEAR PROBLEMS
Nonlinear interaction of tearing modes in highly resistive tokamaks, 4:39992
TECHNETIUM/ENVIRONMENTAL EFFECTS
Chemical approaches to understanding the environmental behavior of Pu, Np, and Tc, 4:39601 (CONF-781105-100)

TECHNETIUM 99/ADSORPTION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
TECHNETIUM 99/BIOLOGICAL ACCUMULATION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
TECHNETIUM 99/ENVIRONMENTAL TRANSPORT
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
TECHNETIUM 99/ROOT ABSORPTION
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
TECHNOLOGY ASSESSMENT/MATHEMATICAL MODELS
Environmental Resources Section, 4:40051 (ORNL-5508)
TECTONICS
Use of combined geophysical studies for investigating the tectonics of the crystalline basement of western regions of the Russian platform, 4:39712
TEMPERATURE (AMBIENT)
See AMBIENT TEMPERATURE
TEMPERATURE MEASUREMENT
Measurement of high-temperature, high-pressure processes. Annual report April 1976-July 1977, 4:38066 (PB-284041)
TENNESSEE/GEOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
TENNESSEE/MAGNETIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle, 4:38218 (GJBX-57(79)(Vol.2)(Knoxville))
TENNESSEE/RADIOMETRIC SURVEYS
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle, 4:38218 (GJBX-57(79)(Vol.2)(Knoxville))
TENNESSEE/SEISMOLOGY
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
TENNESSEE/TECTONICS
New Madrid seismotechtonic study: activities during fiscal year 1978, 4:39710 (NUREG/CR-0450)
TENNESSEE VALLEY REGION/NUCLEAR FACILITIES
Tennessee Valley Region: a year 2000 profile, 4:38757 (DOE/ET-0064/1)
Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations (Includes glossary), 4:38758 (DOE/ET-0064/2)
TENNESSEE VALLEY REGION/NUCLEAR POWER PLANTS
Tennessee Valley Region: a year 2000 profile, 4:38757 (DOE/ET-0064/1)
Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations (Includes glossary), 4:38758 (DOE/ET-0064/2)
TENNESSEE VALLEY REGION/RADIATION DOSES
Tennessee Valley Region: a year 2000 profile, 4:38757 (DOE/ET-0064/1)
Tennessee Valley region study: potential year 2000 radiological dose to population resulting from nuclear facility operations (Includes glossary), 4:38758 (DOE/ET-0064/2)
TERRESTRIAL ECOSYSTEMS
See also RANGELANDS
Terrestrial Ecology Section, 4:38091 (ORNL-5508)
TERRESTRIAL ECOSYSTEMS/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
TERRESTRIAL ECOSYSTEMS/POLLUTION
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
Synthetic Fuels Program, 4:38090 (ORNL-5508)
TEST FACILITIES/SPECIFICATIONS
PBF-LOCA single rod tests program experiment specification document (PWR), 4:38825 (TFBP-TR-279)
TEST FAST BREEDER REACTOR KALPAKKAM
See KALPAKKAM LMFBR REACTOR
TEST PARTICLES/CORRELATION FUNCTIONS
Scaled Boltzmann theory for k-dependent test particle correlation functions in moderately dense gases), 4:39961
TETRAHYDRONAPHTHALENE
See TETRALIN
TETRALIN/CHEMICAL REACTIONS
Coal anion structure and chemistry of coal alkylation. Sixth quarterly progress report, June 1-August 31, 1978, 4:38083 (COO-4227-6)
TEXAS/AGRICULTURE
The impact of rising natural gas prices on agriculture in the Texas High Plains. Executive report, 4:38179 (PB-283975)
TEXTILE INDUSTRY/ENERGY CONSERVATION
Energy use in the New Zealand textile industry, 4:39030
TEXTILE INDUSTRY/ENERGY CONSUMPTION
Energy use in the New Zealand textile industry, 4:39030
TFTR REACTORS/EDDY CURRENTS
Transient eddy currents on finite plane and toroidal conducting surfaces, 4:40008 (PPPL-1517)
TFTR REACTORS/POWER SUPPLIES
Tests of vacuum interrupters for the Tokamak Fusion Test Reactor, 4:40009 (LA-7759-MS)
THERMAL EFFLUENTS
Thermal loading of river systems, 4:39630
THERMAL EFFLUENTS/DIFFUSION
Evaluation of integral and phenomenological models for heated surface plumes with field data, 4:39625
THERMAL EFFLUENTS/ENVIRONMENTAL IMPACTS
Calculation of cooling tower plumes with KUMULUS, 4:39590
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
THERMAL EFFLUENTS/ENVIRONMENTAL TRANSPORT
Regional air pollution study: heat emission inventory. Final report, 4:39585 (PB-284081)
THERMAL EFFLUENTS/FLUID FLOW
Entrainment solutions for jet discharge into deep water, 4:39624
THERMAL EFFLUENTS/MATHEMATICAL MODELS
Numerical modeling of surface thermal plumes, 4:39626
THERMAL EFFLUENTS/MONITORING
Monitoring of thermal effluents: measurement techniques and selected field results, 4:39631
THERMAL EFFLUENTS/REGULATIONS
Proposed issuance of a new source national pollutant discharge elimination system permit and section 10 and section 404 permits to Iowa Southern Utilities Company, Ottumwa generating station. Final environmental impact statement, 4:38600 (PB-285098)
THERMAL EFFLUENTS/THERMODYNAMICS
Two-dimensional numerical models for hydrothermal analysis of water bodies, 4:39629
THERMAL EFFLUENTS/WASTE DISPOSAL
Thermal effluent disposal from power generation, 4:39622
THERMAL ENERGY STORAGE EQUIPMENT/DESIGN
Engineering design for thermocrete central storage units for low temperature solar application. Monthly technical report, August-September 1978, 4:38505 (COO-4702-3)
THERMAL ENERGY STORAGE EQUIPMENT/HEAT EXCHANGERS
Active heat exchange system development for latent heat thermal energy storage, 4:38836 (DOE/NASA/0038-79/1)
THERMAL ENERGY STORAGE EQUIPMENT/RESEARCH PROGRAMS
Low-Temperature Thermal Energy Storage Program. Progress report, October 1978-March 1979, 4:38838 (ORNL/TM-6936)
Low-Temperature Thermal Energy Storage Program. Annual progress report, October 1977-September 1978, 4:38837 (ORNL/TM-6701)
THERMAL INSULATION/FINANCIAL INCENTIVES
National energy plan: energy conservation with insulation. Final report, 4:38993 (HIT-689)
THERMAL INSULATION/STANDARDS
National energy plan: energy conservation with insulation. Final report, 4:38993 (HIT-689)
THERMAL POLLUTION
(Environmental temperature rise due to waste heat disposal)
THERMAL POLLUTION/MATHEMATICAL MODELS
General three-dimensional models for thermal pollution analysis, 4:39627
THERMAL POWER PLANTS
See also COMBINED-CYCLE POWER PLANTS
FOSSIL-FUEL POWER PLANTS
GEOTHERMAL POWER PLANTS
NUCLEAR POWER PLANTS
THERMAL POWER PLANTS/CHEMICAL EFFLUENTS
Analysis of meteorological conditions during the 1977 Anclote Keys Plume Study. Final report, February-November 1977, 4:39559 (PB-284905)
THERMAL POWER PLANTS/COMPUTER SIMULATION
Prediction and indication of process states as aids in power plant control technology (In German), 4:38570 (NP-23706)
THERMAL POWER PLANTS/CONTROL SYSTEMS
Prediction and indication of process states as aids in power plant control technology (In German), 4:38570 (NP-23706)

THERMAL POWER PLANTS/COOLING SYSTEMS
Water consumption and costs for various steam electric power plant cooling systems. Final report, October 1977-January 1978, 4:38575 (PB-285397)
THERMAL POWER PLANTS/COOLING TOWERS
Air radiator cooling tower (Patent), 4:38577
Chalk Point Cooling Tower Project. Volume 2. Cooling tower drift dye tracer experiment, FY77. Final report, 1 July 1976-31 August 1977, 4:39557 (PB-284827)
Chalk Point Cooling Tower Project. Volume I, phase V. Analysis and archiving program, FY77. Final report, 1 July 1976-31 August 1977, 4:39556 (PB-284826)
THERMAL POWER PLANTS/FLUE GAS
Characterization of carbide lime to identify sulfite oxidation inhibitors. Final report Sep 77-Jul 78, 4:38606 (PB-286646)
Process for removing sulfur dioxide from waste gases (Patent), 4:38607
THERMAL POWER PLANTS/OPERATION
Optimum hydrothermal electric energy system scheduling: challenges and opportunities in research and development in Canada, 4:38572
THERMAL POWER PLANTS/THERMAL EFFLUENTS
Proposed issuance of a new source national pollutant discharge elimination system permit and section 10 and section 404 permits to Iowa Southern Utilities Company, Ottumwa generating station. Final environmental impact statement, 4:38600 (PB-285098)
THERMAL POWER PLANTS/WASTE HEAT
Analysis of the control and performance of algal-wastewater stabilization ponds. Technical report, 4:39041 (PB-285709)
THERMAL POWER PLANTS/WATER REQUIREMENTS
Water consumption and costs for various steam electric power plant cooling systems. Final report, October 1977-January 1978, 4:38575 (PB-285397)
THERMAL POWER PLANTS/WATER RESOURCES
Water for power plant cooling, 4:38574 (PB-285126)
THERMAL WATERS/AQUACULTURE
Recent developments in geothermal multipurpose utiliztaion in Jozankei Hot Springs in Sapporo City, 4:38552
THERMAL WATERS/MAPS
Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790, 4:38514
Geothermal energy in Alaska and Hawaii. Map 2 of U.S. Geological Survey Circular 790, 4:38515
THERMAL WATERS/USES
Report of the Geothermal Utilization Committee, 4:38549
THERMIONIC CONVERSION/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
THERMIONIC CONVERTERS/PERFORMANCE
Performance of a thermionic converter module utilizing emitter and collector heat pipes, 4:38985 (N-78-27174)
THERMOCOUPLES/DATA ANALYSIS
Manifestations of nonlinearity in fuel center thermocouple steady-state and transient data: implications for data analysis, 4:38750 (NUREG/CR-0220)
THERMOELECTRIC GENERATORS
Selected advances in materials research, 4:39106 (CONF-790343-1)
THERMOELECTRIC GENERATORS/MATERIALS
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM-6660)
THERMOLUMINESCENT DOSEMETERS/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
THERMONUCLEAR POWER PLANTS/FORECASTING
Fusion power development issues. Final report, 4:38942 (PB-285566)
THERMONUCLEAR POWER PLANTS/PLANNING
Fusion power development issues. Final report, 4:38942 (PB-285566)
THERMONUCLEAR REACTOR WALLS
See also FIRST WALL
THERMONUCLEAR REACTOR WALLS/ION IMPLANTATION
Hydrogen isotope trapping in materials exposed in PLT, 4:40006 (PPPL-1537)
THERMONUCLEAR REACTORS
(For use in cases where certain aspects of either hypothetical or real thermonuclear reactors are discussed.)
See also DOUBLET REACTORS
I-BEAM TYPE REACTORS
LASER FUSION REACTORS
PLT REACTORS
TFTR REACTORS
THERMONUCLEAR REACTOR WALLS
TMR REACTORS
TOKAMAK TYPE REACTORS
THERMONUCLEAR REACTORS/DESIGN
Conceptual design of the Fast-Liner Reactor (FLR) for fusion power, 4:40001 (LA-7686-MS)
THERMONUCLEAR REACTORS/FUEL CYCLE
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
THERMONUCLEAR REACTORS/INERTIAL CONFINEMENT
Self-similar power-driven expansion into vacuum, 4:40017
THERMONUCLEAR REACTORS/MEETINGS
Controlled fusion and plasma physics. Vol. II, 4:40003 (INIS-mf-4125)
Controlled fusion and plasma physics. Workshop on stellarators, 4:40004 (INIS-mf-4324)
THERMONUCLEAR REACTORS/NEUTRON TRANSPORT
Transport and reactor theory. Progress report, October 1-December 31, 1978, 4:38724 (LA-7704-PR)
THERMONUCLEAR REACTORS/RADIATION HAZARDS
Control of beryllium-7 in liquid lithium, 4:40013 (HEDL-SA-1594-FP)
THERMONUCLEAR REACTORS/RADIOACTIVE EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
THERMONUCLEAR REACTORS/SYNTHETIC FUELS
Fusion reactors for synthetic fuels, 4:38301 (BNL-25634)
One- and two-dimensional heating analyses of fusion synfuel blankets, 4:40005 (BNL-NUREG-25635)
THERMONUCLEAR REACTORS/THERMAL EFFLUENTS
Comprehensive standards: the power generation case, 4:38599 (PB-286024)
THERMOS REACTOR/COST BENEFIT ANALYSIS
Desalination applications of Thermos, 4:38711 (IAEA-206)
THERMOS REACTOR/DESALINATION
Desalination applications of Thermos, 4:38711 (IAEA-206)
THERMOS REACTOR/FEASIBILITY STUDIES
Thermos reactor, 4:38718 (TECHNICATOME-CONF-77-1)
THERMOS REACTOR/SPECIFICATIONS
Desalination applications of Thermos, 4:38711 (IAEA-206)
Thermos reactor, 4:38718 (TECHNICATOME-CONF-77-1)
THIO COMPOUNDS
See ORGANIC SULFUR COMPOUNDS
THIOETHERS
See SULFIDES
THIOLS/GAS CHROMATOGRAPHY
Analytical system for measuring malodorous compounds from kraft mills. Final report, 4:39560 (PB-284938)
THORIUM/METALLURGICAL EFFECTS
Electron-beam welding of thorium-doped iridium alloy sheets (Ir-0.3% W 200 ppM Th-50 ppM Al), 4:39092 (ORNL/TM-6711)
THORIUM 230/RADIOECOLOGICAL CONCENTRATION
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
THORIUM 232 TARGET/OXYGEN 16 REACTIONS
Energy dependence of peripheral reactions induced by heavy ions (Differential cross sections, 140 and 315 MeV, yields), 4:39915
THORIUM CYCLE
Nuclear energy from thorium. An introduction, 4:38723 (INS-R-230)
Reactor physics parameters of alternate fueled FBR core designs, 4:38668 (HEDL-SA-1329)
THORIUM OXIDES/LOSSES
Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility, 4:38235 (WCAP-9278)
TIDAL POWER/REVIEWS
Harnessing tidal energy. Current issue outline, 4:38554 (PB-286671)
TIDAL POWER PLANTS
Review of optimization and economic evaluation of potential tidal power developments in the Bay of Fundy, 4:38555
TIDAL POWER PLANTS/DESIGN
Tidal power plant and method of power generation (Patent), 4:38556
TIN/NEUTRON REACTIONS
Doppler effect measurements on solid and liquid Sn (24 keV), 4:39910 (CONF-790602-41)
TIN ALLOYS/EMBRITTLEMENT
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
TIN ALLOYS/MECHANICAL PROPERTIES
Fabrication and properties of conductors for fusion magnets. Annual report, October 1, 1976-September 30, 1977 (Nb_3Sn conductor testing), 4:39269 (BNL-50961)
TISSUES
See also BONE MARROW
EPITHELIUM
SKIN

TISSUES/RADIATION DOSES
Distribution of injected plutonium in the skeleton and certain soft tissues (^{239}Pu), 4:39688 (ANL-78-65(Pt.2))
TITANATES/SPUTTERING
Radio-frequency-sputtered tetragonal barium titanate films on silicon, 4:39180
TITANIUM/ELECTRONIC STRUCTURE
X-ray absorption fine structure above the Ti L edge, 4:39158
TITANIUM/EMISSION SPECTROSCOPY
Spectral method for determining impurities in anthracite and oil coke, 4:38084
TITANIUM/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
TITANIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
TITANIUM/NITRIDATION
Ion nitriding of titanium and zirconium by a dc-glow discharge method (Surface phases), 4:39099
TITANIUM/SORPTIVE PROPERTIES
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
Theoretical studies of chemisorption on transition metal surfaces: interaction of hydrogen with titanium, 4:39229 (LBL-8975)
TITANIUM/SPUTTERING
Application of matrix isolation spectroscopy to the measurement of sputtering yields, 4:39098
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
TITANIUM/SUBLIMATION
Performance of vacuum components operating at 1 x 10^{-11} Torr, 4:39486
TITANIUM/X-RAY SPECTRA
X-ray absorption fine structure above the Ti L edge, 4:39158
TITANIUM ALLOYS
See also TITANIUM BASE ALLOYS
TITANIUM ALLOYS/CORROSION PROTECTION
Corrosion inhibition in sputter-deposited thin-film systems using an intermediary layer of palladium, 4:39162
TITANIUM ALLOYS/EMBRITTLEMENT
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
TITANIUM ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
TITANIUM ALLOYS/SORPTIVE PROPERTIES
Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM-2600(TR))
TITANIUM BASE ALLOYS/CREEP
Strainrange partitioning applied to Ti-6Al-V, 4:39140
TITANIUM BASE ALLOYS/FATIGUE
Strainrange partitioning applied to Ti-6Al-V, 4:39140
TITANIUM HYDRIDES/CRYSTAL STRUCTURE
Proton magnetic resonance studies of TiCuH, 4:39176
TITANIUM HYDRIDES/SPIN-LATTICE RELAXATION
Proton magnetic resonance studies of TiCuH, 4:39176
TITANIUM SELENIDES/LATTICE PARAMETERS
Phonons and charge density waves in 1T-$TiSe_2$, 4:39190
TITANIUM SELENIDES/PHASE TRANSFORMATIONS
Phonons and charge density waves in 1T-$TiSe_2$, 4:39190
TMR REACTORS/SPECIFICATIONS
Improved tandem mirror fusion reactor, 4:40002 (UCID-18156)
TOBACCO SMOKES/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
TOKAMAK DEVICES/BEAM INJECTION HEATING
Properties of an intense 40-kV neutral beam injector, 4:40011
TOKAMAK DEVICES/ELECTRON TEMPERATURE
Theory of electron energy confinement in tokamaks, 4:39968
TOKAMAK DEVICES/MATERIALS TESTING
UHV compatibility of two possible fusion reactor materials: K-ramic/sup R/ and ATJ graphite, 4:40023
TOKAMAK DEVICES/PLASMA BEAM INJECTION
Experimental test of the feasibility of heating tokamaks by gun injection, 4:40012
TOKAMAK DEVICES/PLASMA DIAGNOSTICS
Diagnosis of high-temperature hydrogen plasma by the resonance fluorescence method, 4:39975
TOKAMAK DEVICES/PLASMA HEATING
Nonlinear evolution of lower hybrid waves, 4:39999
TOKAMAK DEVICES/RESEARCH PROGRAMS
High-beta tokamak research. Quarterly status report, 1 October-31 December 1978 (Torus 1 and Torus 2 diagnostics), 4:39971 (COO-2456-76)
TOKAMAK DEVICES/TEARING INSTABILITY
Nonlinear interaction of tearing modes in highly resistive tokamaks, 4:39992
TOKAMAK DEVICES/TRANSPORT THEORY
Anomalous alpha-particle transport in thermonuclear tokamak plasma, 4:39982
TOKAMAK TYPE REACTORS
See also DOUBLET REACTORS
NUMAK REACTORS
PLT REACTORS
TFTR REACTORS
TOKAMAK TYPE REACTORS/BREEDING BLANKETS
Tokamak reactors and structural materials, 4:40007 (UWFDM-288)
TOKAMAK TYPE REACTORS/FIRST WALL
Tokamak reactors and structural materials, 4:40007 (UWFDM-288)
TOLUENE/COMBUSTION PRODUCTS
Fundamental characterization of alternate fuel effects in continuous combustion systems, 4:38592 (SAN-1543-12)
TOTAL ENERGY SYSTEMS/DESIGN
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
TOTAL ENERGY SYSTEMS/TOWER FOCUS POWER PLANTS
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
TOWER FOCUS POWER PLANTS/DESIGN
Solar energy system design for a lobster aquaculture facility, 4:38485 (COO-4274-1)
Technical and economic assessment of solar hybrid repowering. Final report, 4:38409 (SAN-1608-4-2)
TOWER FOCUS POWER PLANTS/HEAT EXCHANGERS
Small particle heat exchangers, 4:38407 (LBL-7841)
TOWER FOCUS POWER PLANTS/HYBRID SYSTEMS
Technical and economic assessment of solar hybrid repowering. Final report, 4:38409 (SAN-1608-4-2)
TRACER TECHNIQUES/SAMPLE PREPARATION
Apparatus for sectioning diffusion specimens in liquid nitrogen, 4:39512
TRANS 104 ELEMENTS/NATURAL OCCURRENCE
Detection of a new spontaneously fissioning nuclide in some meteorites, 4:39919 (BNL-tr-678)
TRANSDUCERS/DESIGN
Microinterferometer transducer, 4:39510 (Y/DA-7109)
Rupture-safe pressure transducers, 4:39509 (UCRL-82358)
TRANSDUCERS/PERFORMANCE
Rupture-safe pressure transducers, 4:39509 (UCRL-82358)
TRANSFER (HEAT)
See HEAT TRANSFER
TRANSPORT
(Limited to the movement of goods and persons.)
See also AIR TRANSPORT
LAND TRANSPORT
PNEUMATIC TRANSPORT
TRANSPORTATION SYSTEMS
See also MASS TRANSIT SYSTEMS
TRANSPORTATION SYSTEMS/COMPARATIVE EVALUATIONS
Phase 1: definition of intercity transportation comparison framework. Volume 1: summary. Final report, 4:39021 (N-78-28993)
Phase 1: definition of intercity transportation comparison framework. Volume 2: methodology. Final report, 4:39022 (N-78-28994)
TRANSPORTATION SYSTEMS/COST
Phase 1: definition of intercity transportation comparison framework. Volume 1: summary. Final report, 4:39021 (N-78-28993)
Phase 1: definition of intercity transportation comparison framework. Volume 2: methodology. Final report, 4:39022 (N-78-28994)
TRANSPORTATION SYSTEMS/DATA ANALYSIS
Study of set-theoretic information processing, 4:38859 (UCRL-13970)
TRANSPORTATION SYSTEMS/ECONOMICS
Considerations on some economic and environmental problems related to energy production, part 3, 4:39633 (N-78-28671)
TRANSPORTATION SYSTEMS/ENERGY CONSUMPTION
Phase 1: definition of intercity transportation comparison framework. Volume 1: summary. Final report, 4:39021 (N-78-28993)
TRANSPORTATION SYSTEMS/ENVIRONMENTAL IMPACTS
Considerations on some economic and environmental problems related to energy production, part 3, 4:39633 (N-78-28671)
TREES
See also EUCALYPTUSES

TREES/PLANT GROWTH
Comparison of sludge and fertilizer applications on establishment and growth of seedlings of two sweetgum ecotypes endomycorrhizal with Glomus mosseae and G. etunicatus. Establishment and progress report, 4:39658 (SRO-0870-5)
TREES/POPULATION DYNAMICS
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
TREES/SPECIES DIVERSITY
Shrub and tree data for plant associations across the Mojave/Great Basin Desert transition of the Nevada Test Site, 1963-1975, 4:39607 (DOE/EV-2307-15)
TRIBOLOGY/MEETINGS
Piston ring scuffing, 4:39078
TRIODE TUBES/MICROWAVE AMPLIFIERS
Microwave generation in the reflex triode, 4:39424 (CONF-771035-P2)
TRIODE TUBES/MICROWAVE SPECTRA
Microwave generation in the reflex triode, 4:39424 (CONF-771035-P2)
TRIPLET PARTICLES
See QUARKS
TRITIUM/BIOLOGICAL ACCUMULATION
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{3}H (Mice), 4:39692 (BNL-25910)
TRITIUM/ENERGY LEVELS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
TRITIUM/LATTICE PARAMETERS
Phonons and charge density waves in 1T-$TiSe_2$, 4:39190
TRITIUM/NUCLEAR MAGNETIC RESONANCE
Proton magnetic resonance studies of TiCuH, 4:39176
TRITIUM/PHASE TRANSFORMATIONS
Phonons and charge density waves in 1T-$TiSe_2$, 4:39190
TRITIUM/RADIOACTIVE WASTE DISPOSAL
Removal, storage and disposal of gaseous radionuclides from airborne effluents. Report of a technical committee meeting organized by the IAEA and held in Vienna, 20-24 September 1976, 4:38251 (IAEA-209)
TRITIUM/TISSUE DISTRIBUTION
Aquatic Ecology Section (^{60}Co, ^{137}Cs, ^{3}H), 4:39620 (ORNL-5508)
TRITIUM IONS/ION BEAMS
Synopsis of tritium running at Penn, 4:39367 (LA-7445-C)
TRITIUM OXIDES/COMPARATIVE EVALUATIONS
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL-25730)
TRITIUM OXIDES/RADIATION HAZARDS
Genetic hazard of ^{3}H: estimation by oocyte uptake of ^{3}H (Mice), 4:39692 (BNL-25910)
TRITIUM TARGET/TRITON REACTIONS
Theory and evaluation of nuclear cross sections: fusion reactions, 4:39884 (LA-7722-PR)
TRITON REACTIONS/COMPOUND-NUCLEUS REACTIONS
Theory and evaluation of nuclear cross sections: fusion reactions, 4:39884 (LA-7722-PR)
TRITON REACTIONS/PICKUP REACTIONS
Levels in ^{165}Ho populated in the $^{166}Er(t(pol),\alpha)$ reaction (Polarization, 17 MeV, analyzing powers, j, Nilson-model assignments), 4:39913
TRITON REACTIONS/STRIPPING
Total angular momentum determinations from the (t/sub pol/,d) reaction on /sup 58,64/Ni, 4:39904
TRONA/ENVIRONMENTAL IMPACTS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
TRONA/HEALTH HAZARDS
Source assessment: chemical and fertilizer mineral industry, state-of-the-art. Final report, October 1976-August 1977, 4:39567 (PB-285662)
TROPOSPHERE/AEROSOLS
Tropospheric aerosols, 4:39535
TROPOSPHERE/RADIOACTIVE AEROSOLS
Radioactive emanations and the formation and composition of aerosols, 4:39584
TROPOSPHERE/SULFATES
Dominance of tropospheric sulfate in modifying solar radiation, 4:39536
TRUCKS
Comparative coal transportation costs: an economic and engineering analysis of truck, belt, rail, barge and coal slurry and pneumatic pipelines. Volume 6. Truck haulage. Final report, 4:38115 (DOE/TIC-10053(Vol.6))
TRUCKS/AIR INFILTRATION
Air leakage in refrigerated vans. Final report, 4:39020 (COO-4338-4)
TRUCKS/FUEL ECONOMY
Utilization of waste heat in trucks for increased fuel economy, 4:39053 (N-78-27532)
TRUCKS/WASTE HEAT UTILIZATION
Utilization of waste heat in trucks for increased fuel economy, 4:39053 (N-78-27532)
TRYPTOPHAN/CATALYTIC EFFECTS
Mechanism of suppression in Drosophila. VII. Correlation between disappearance of an isoacceptor of tyrosine tRNA and activation of the vermilion locus, 4:39645
TUMORS
See NEOPLASMS
TUNGSTEN/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
TUNGSTEN/SPUTTERING
Measurements of sputtering yields for low-energy plasma ions, 4:40020 (PPPL-1521)
TUNGSTEN ALLOYS
See also TUNGSTEN BASE ALLOYS
TUNGSTEN ALLOYS/CHEMICAL COMPOSITION
Selected advances in materials research, 4:39106 (CONF-790343-1)
TUNGSTEN ALLOYS/FATIGUE
Strainrange partitioning of Mar 002 over the temperature range 750°C-1040°C, 4:39138
TUNGSTEN BASE ALLOYS/COMPATIBILITY
Compatibility of Pt-3008 with selected components of the selenide isotope generator system, 4:38302 (ORNL/TM-6660)
TUNGSTEN CARBIDES/CATALYTIC EFFECTS
Catalytic activity of transition-metal carbides, 4:38989 (LBL-8975)
TUNGSTEN CARBIDES/ELECTRICAL PROPERTIES
Catalytic activity of transition-metal carbides, 4:38989 (LBL-8975)
TUNGSTEN IONS/ION-ATOM COLLISIONS
Theory of electron transfer and ionization, 4:39789 (CONF-790438-1)
TUNNELS/DESIGN
Design analysis of annular tunnels for superconductive energy storage using the finite element method, 4:38832
TURBINE BLADES/COOLING
Liquid-cooled turbine bucket with enhanced heat transfer performance (Patent), 4:38586
TURBINE BLADES/CORROSION
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N-78-28225)
TURBINE BLADES/DESIGN
Multiple-piece ceramic turbine blade (Patent), 4:38587
TURBINE BLADES/EROSION
Errosion/corrosion of turbine airfoil materials in the high-velocity effluent of a pressurized fluidized coal combustor, 4:38126 (N-78-28225)
TURBINE BLADES/FABRICATION
Multiple-piece ceramic turbine blade (Patent), 4:38587
TURBINE BLADES/RESEARCH PROGRAMS
Brittle materials design, high-temperature gas turbine: Ceramic Turbine Rotor Technclogy. Interim report No. 13, October 1977-March 1978, 4:39073 (AMMRC-TR-79-11)
TURBULENT FLOW/SPECTRAL FUNCTIONS
Spectral variance estimation and the analysis of turbulence data, 4:39983
TURKEY/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
TWO-FIREBALL MODEL
See FIREBALL MODEL

U

UCLLL
See LAWRENCE LIVERMORE LABORATORY
UHF RADIATION (01-100 GHZ)
See RADIOWAVE RADIATION
UHF RADIATION (100-1000 MHZ)
See RADIOWAVE RADIATION
UHF RADIATION (LOWER RANGE)
See RADIOWAVE RADIATION

UHF RADIATION (UPPER RANGE)
See RADIOWAVE RADIATION
UHV AC SYSTEMS/CIRCUIT BREAKERS
Fundamental techniques for gas-insulated apparatus, 4:38618
UHV AC SYSTEMS/SWITCHES
Fundamental techniques for gas-insulated apparatus, 4:38618
ULTRASONIC TESTING
Baseline inspection of three transition joint life test articles (LMFBR), 4:38666 (GEFR-00414)
UNDERGROUND BUILDINGS
See EARTH-COVERED BUILDINGS
UNDERGROUND DISPOSAL/INFORMATION SYSTEMS
Burial ground technology, 4:39603 (ORNL-5508)
UNDERGROUND DISPOSAL/RESEARCH PROGRAMS
Burial ground technology, 4:39603 (ORNL-5508)
UNDERGROUND MINING
See also LONGWALL MINING
OIL SHALE MINING
UNDERGROUND MINING/CUTTER LOADERS
Present state and directions of progress in mechanization of development work, 4:38109
UNDERGROUND MINING/HEADING MACHINES
Present state and directions of progress in mechanization of development work, 4:38109
UNDERGROUND MINING/MATHEMATICAL MODELS
A closed network queue model of underground coal mining production, failure, and repair, 4:38098 (N-78-30636)
UNDERGROUND MINING/MINE ROADWAYS
Present state and directions of progress in mechanization of development work, 4:38109
UNDERGROUND MINING/MINING EQUIPMENT
Development trends in remote control systems used in Soviet mining, 4:38096
Mining machine (PAtent), 4:38108
UNDERGROUND MINING/POWERED SUPPORTS
Control of self-advancing mine roof supports (Patent), 4:38105
UNDERGROUND MINING/SUPPORTS
Hydraulic mine prop (Patent), 4:38107
UNDERGROUND MINING/TECHNOLOGY ASSESSMENT
A life-cycle description of underground coal mining. Interim technical report, 4:38097 (N-78-28586)
UNIFIED GAUGE MODELS/PROTONS
Mechanisms of proton stability and decay in unified models (Review, Yang-Mills theory, mechanisms), 4:39863 (LA-UR-79-361)
UNIFIED GAUGE MODELS/REVIEWS
Some remarks on grand unified models, 4:39835 (UH-511-330-79)
UNIPOLAR TRANSISTORS
See FIELD EFFECT TRANSISTORS
UNITED KINGDOM/ELECTRIC UTILITIES
Electrical load management: the British experience. Part II (Nighttime demand at record highs), 4:38937
UNITED KINGDOM/RADIOACTIVE WASTE DISPOSAL
Status report for the United Kingdom, 4:38278
UNITED STATES OF AMERICA
See USA
UNIVERSE/ANTIMATTER
Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
UNIVERSE/MATTER
Matter-antimatter accounting, thermodynamics, and black-hole radiation, 4:39737
UPSILON RESONANCES/QUARK MODEL
Lecture V. The new new particles, 4:39830 (FERMILAB-CONF-78/37-THY)
UPSILON RESONANCES/REVIEWS
Lecture V. The new new particles, 4:39830 (FERMILAB-CONF-78/37-THY)
URACILS/BIOCHEMICAL REACTION KINETICS
Enzymatic degradation of uracil-containing deoxyribonucleic acid. V. Survival of Escherichia coli and coliphages treated with sodium bisulfite, 4:39641
URANIUM
See also URANIUM-ALPHA
URANIUM/ENVIRONMENTAL EFFECTS
Environmental Sciences Division annual progress report for period ending September 30, 1978. Environmental Sciences Division publication No. 1280, 4:39581 (ORNL-5508)
URANIUM/ENVIRONMENTAL IMPACTS
Environmental Impacts Program, 4:38089 (ORNL-5508)
URANIUM/EVALUATION
Environmental Impacts Program, 4:38089 (ORNL-5508)
URANIUM/HYPERFINE STRUCTURE
Hyperfine structure measurements of high-lying levels of uranium, 4:39787
URANIUM/PHOTOCHEMICAL REACTIONS
Photochemistry of the actinides, 4:39253 (CONF-790415-21)
URANIUM/PROSPECTING
Uranium potential and geology of the Challis Volcanics of the Basin Creek-Yankee Fork Area, Custer County, Idaho. Final report, 4:38206 (GJBX-33(79))
URANIUM/RADIOECOLOGICAL CONCENTRATION
Progress report on a study of contamination of the human food chain by uranium mill tailings piles (^{230}Th, ^{226}Ra, ^{210}Pb, ^{210}Po), 4:39600 (ANL-78-65(Pt.2))
URANIUM 232/ENERGY LEVELS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 232/PAIRING INTERACTIONS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 233/CRITICALITY
Validation of the KENO and SU-HAMMER codes for critical solution systems of U-233 and U-235, 4:39276 (AECL-5917)
URANIUM 233/ISOTOPE PRODUCTION
Electronuclear fissile fuel production. Linear accelerator fuel regenerator and producer LAFR and LAFP, 4:38225
URANIUM 234/ENERGY LEVELS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 234/PAIRING INTERACTIONS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 235/CALORIMETRY
Calorimetric assay of HTGR fuel samples, 4:38226 (ORNL/TM-6665)
URANIUM 235/CRITICALITY
Validation of the KENO and SU-HAMMER codes for critical solution systems of U-233 and U-235, 4:39276 (AECL-5917)
URANIUM 235/NONDESTRUCTIVE ANALYSIS
Savannah River Plant Californium-252 Shuffler software manual (ASSAY; TEST), 4:38291 (LA-7717-M)
URANIUM 235 TARGET/NEUTRON BEAMS
Neutron physics at LASL, 4:39378
URANIUM 235 TARGET/NEUTRON REACTIONS
Absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu at 13.9 and 14.6 MeV, 4:39927
Calculation of prompt fission neutron spectra, 4:39917 (LA-7722-PR)
Energy dissipation in ^{235}U(n/sub th/,f) (Energy losses, potential energy), 4:39918 (ORO-5126-62)
Fission product yields from 6-9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis, 4:39926 (AD-A-059327)
Neutron flux monitoring and data analysis for neutron standard reaction cross sections (5 to 800 KeV), 4:39943
URANIUM 236/ENERGY LEVELS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 236/PAIRING INTERACTIONS
Octupole-octupole residual interactions and low-lying 0^+ excited states in the isotopes ^{232}U, ^{234}U, and ^{236}U, 4:39916
URANIUM 238 TARGET/NEUTRON REACTIONS
Absolute neutron fission cross sections of ^{235}U, ^{238}U, and ^{239}Pu at 13.9 and 14.6 MeV, 4:39927
Fission product yields from 6-9 MeV neutron induced fission of ^{235}U and ^{238}U. Doctoral thesis, 4:39926 (AD-A-059327)
URANIUM 238 TARGET/OXYGEN 16 REACTIONS
Incomplete momentum transfer in peripheral heavy-ion collisions at 20 MeV/nucleon, 4:39925
URANIUM 238 TARGET/PROTON REACTIONS
Energy and angular correlation of He ions and heavy fragments in 11.5-GeV proton bombardment of uranium, 4:39924
URANIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
URANIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
URANIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
URANIUM CONCENTRATES/ACCIDENTS
Study of the mechanics of a transportation accident involving natural uranium concentrate. Final report, June 8, 1978-September 8, 1978, 4:38244 (NUREG/CR-0558)
URANIUM CONCENTRATES/LAND TRANSPORT
Study of the mechanics of a transportation accident involving natural uranium concentrate. Final report, June 8, 1978-September 8, 1978, 4:38244 (NUREG/CR-0558)

URANIUM DEPOSITS/AERIAL PROSPECTING
Airborne gamma-ray spectrometer and magnetometer survey: Prescott Quadrangle (Arizona). Final report, 4:38219 (GJBX-59(79)(Vol.2)(Prescott))
Airborne gamma-ray spectrometer and magnetometer survey: Williams Quadrangle (Arizona). Final report, 4:38220 (GJBX-59(79)(Vol.2)(Williams))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Juneau Quadrangle, 4:38211 (GJBX-48(79)(Vol.2)(Juneau))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Ketchikan Quadrangle, 4:38212 (GJBX-48(79)(Vol.2)(Ketchikan))
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 Quadrangle, 4:38218 (GJBX-57(79)(Vol.2)(Knoxville))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Atlin Quadrangle, 4:38208 (GJBX-48(79)(Vol.2)(Atlin))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Bradfield Canal Quadrangle, 4:38209 (GJBX-48(79)(Vol.2)(Bradfield))
NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Charlotte NI 17-2 Quadrangle, 4:38217 (GJBX-57(79)(Vol.2)(Charlotte))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Craig Quadrangle, 4:38210 (GJBX-48(79)(Vol.2)(Craig))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Petersburg Quadrangle, 4:38213 (GJBX-48(79)(Vol.2)(Petersburg))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sitka Quadrangle, 4:38214 (GJBX-48(79)(Vol.2)(Sitka))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Sumdum Quadrangle, 4:38216 (GJBX-48(79)(Vol.2)(Sumdum))
NURE aerial gamma-ray and magnetic reconnaissance survey: southeastern area-Alaska, Skagway Quadrangle, 4:38215 (GJBX-48(79)(Vol.2)(Skagway))
URANIUM DEPOSITS/GEOCHEMICAL SURVEYS
Hydrogeochemical and stream sediment reconnaissance program in central United States. Semiannual progress report, October 1, 1978-March 31, 1979, 4:38222 (K/UR-21(Pt.2))
Savannah River Laboratory hydrogeochemical and stream sediment reconnaissance. Orientation study data release VII, Wolcott, Vermont, area. National Uranium Resource Evaluation Program (Udall Mine), 4:38207 (GJBX-43(79))
URANIUM DEPOSITS/PROSPECTING
NURE plans and progress, 4:38221 (GJO-108(78))
URANIUM DEPOSITS/REMOTE SENSING
Electro-optical detection of uranium-238 decay products in the atmosphere. LIDAR remote sensing techniques are studied to determine effectiveness in detecting uranium ore. Final report February 1976-January 1978, 4:38205 (AD-A-057797)
URANIUM DIOXIDE/CRITICALITY
Criticality data for $(Pu,U)O_2$ fuel, 4:39275 (AECL-5807(rev.1))
URANIUM DIOXIDE/CRYSTAL STRUCTURE
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341-2)
URANIUM DIOXIDE/LOSSES
Summary report of phase I residual holdup measurements for a mixed oxide fuel fabrication facility, 4:38235 (WCAP-9278)
URANIUM DIOXIDE/MOLECULE COLLISIONS
Molecular beam study of the kinetics of the fluorine-uranium dioxide reaction, 4:39782
URANIUM DIOXIDE/PHYSICAL RADIATION EFFECTS
Cesium migration in LMFBR fuel pins, 4:38671 (HEDL-SA-1543-FP)
URANIUM DIOXIDE/PNEUMATIC TRANSPORT
State-of-the-art survey of pneumatic powder transport, 4:38233 (WCAP-9189)
URANIUM DIOXIDE/REDUCTION
Chemical reduction of refractory oxides by atomic hydrogen, 4:39254 (LBL-8548)
URANIUM ISOTOPES/AVAILABILITY
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
URANIUM ISOTOPES/HEALTH HAZARDS
Actinide elements in aquatic and terrestrial environments, 4:39602 (ORNL-5508)
URANIUM MINES/PLANNING
Uranium mining and milling. The need, the processes, the impacts, the choices. Administrator's guide. Final report, 4:38223 (PB-286034)
URANIUM-ALPHA/CRYSTAL-PHASE TRANSFORMATIONS
Observation of superstructure in α-U near 43 K, 4:39102 (CONF-790341-1(Draft))
URBAN AREAS/ENERGY CONSERVATION
Science advisor report to Burbank City Council, 1975-1976, 4:39051 (PB-283860)
URBAN AREAS/POWER DEMAND
Science advisor report to Burbank City Council, 1975-1976, 4:39051 (PB-283860)
URBAN AREAS/WATER REQUIREMENTS
Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976-30 September 1977, 4:38888 (PB-286038)
URINE/CHEMICAL ANALYSIS
Method for the determination of ^{241}Am in urine (^{243}Am), 4:39199 (ANL-78-65(Pt.2))
US DOD/ENERGY POLICY
The Department of Defense's alternate energy policy. Final report, 4:38915 (AD-A-058200)
US DOE
See also BNL
HANFORD RESERVATION
IDAHO CHEMICAL PROCESSING PLANT
IDAHO NATIONAL ENGINEERING LABORATORY
LASL
LAWRENCE LIVERMORE LABORATORY
SANDIA LABORATORIES
SAVANNAH RIVER PLANT
SOLAR ENERGY RESEARCH INSTITUTE
Y-12 PLANT
US DOE/RESEARCH PROGRAMS
Report of the Office of Science and Technology Policy Working Group on Basic Research in the Department of Energy , 4:38891 (NP-23403)
Summaries of FY 1978 research in nuclear physics, 4:39877 (DOE/ER-0020)
US EPA/RESEARCH PROGRAMS
Cooling tower plume research U.S. Environmental Protection Agency, 4:39589
USA
See also ALABAMA
ALASKA
APPALACHIA
ARIZONA
ARKANSAS
CALIFORNIA
COLORADO
FLORIDA
GREAT LAKES REGION
IDAHO
ILLINOIS
INDIANA
KENTUCKY
LOUISIANA
MIDWEST REGION
MINNESOTA
MISSOURI
MONTANA
NEBRASKA
NEW HAMPSHIRE
NEW MEXICO
NEW YORK
NORTH CAROLINA
NORTH DAKOTA
OHIO
PACIFIC NORTHWEST REGION
SOUTH CAROLINA
SOUTH DAKOTA
TENNESSEE
TEXAS
VERMONT
WASHINGTON
WYOMING
USA/ELECTRIC UTILITIES
Gas-turbine electric plant construction cost and annual production expenses, 1976. Energy data report fourth annual supplement (520 plants), 4:38590 (DOE/EIA-0180)
USA/GEOTHERMAL POWER PLANTS
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
USA/RESEARCH PROGRAMS
Federal R and D funding: modest gains in 1979, 4:38510

USA/WATER REQUIREMENTS
The nation's water resources: the Second National Water Assessment. Part III. Functional water uses, 4:38883 (PB-285749)
USA/WATER RESOURCES
The nation's water resources, the Second National Water Assessment, summary report, 4:38880 (PB-285746)
The nation's water resources: the Second National Water Assessment. Part I. Introduction, 4:38881 (PB-285747)
The nation's water resources: the Second National Water Assessment. Part II. Water management problem profiles, 4:38882 (PB-285748)
The nation's water resources: the Second National Water Assessment. Part III. Functional water uses, 4:38883 (PB-285749)
The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations, 4:38884 (PB-285750)
The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries, 4:38885 (PB-285751)
The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data, 4:38886 (PB-285815)
USA/WIND POWER
Wind power climatology of the United States: supplement, 4:38562 (SAND-78-1620)
USSR/GEOTHERMAL POWER PLANTS
Geothermal power plants of the Soviet Union. A technical survey of existing and planned installations, 4:38534 (COO-4051-41)
Summary of the technical specifications of the geothermal power plants in the world: revision 1. Report no. CATMEC/21, 4:38532 (COO-4051-27)
USSR/NATURAL GAS DEPOSITS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135
USSR/PETROLEUM DEPOSITS
Mathematical methods of separating out perspective sections for gas and oil in the platform region of the Bashkirs, 4:38135
USSR/SEISMIC SURVEYS
Seismic surveys by reflected waves on the Russian platform, 4:39713
USSR/TECTONICS
Use of combined geophysical studies for investigating the tectonics of the crystalline basement of western regions of the Russian platform, 4:39712

V

V TROUGH COLLECTORS/HEAT EXCHANGERS
Small particle heat exchangers, 4:38407 (LBL-7841)
VACUUM STATES/EXPECTATION VALUE
Vacuum expectation values of Higgs scalars in a SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge model, 4:39869
VACUUM SYSTEMS/DESIGN
Versatile UHV sample transfer system, 4:40022
VACUUM SYSTEMS/LEAK TESTING
Measurement error in pressure-decay leak testing, 4:39259 (ORNL/TM-6855)
VACUUM SYSTEMS/PHYSICAL RADIATION EFFECTS
Neutral molecule desorption from SS(304) and Al(6061) due to particle bombardments, 4:39466 (BNL-25733)
VAN DE GRAAFF ACCELERATORS/BEAM STRIPPERS
Comments on Coulomb explosion experience at Brookhaven, 4:39399 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/BEAM TRANSPORT
Improved MP acceleration tube performance, 4:39374 (LA-7445-C)
Synopsis of tritium running at Penn, 4:39367 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/BREAKDOWN
Problems with our upgraded 3-MV machine, 4:39365 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/ELECTRICAL INSULATORS
Experience with accelerating tubes, 4:39376 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/ELECTROSTATICS
Belt charging system, characteristics, problems, structures, 4:39364 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/GASES
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/ION SOURCES
Brookhaven terminal ion source, 4:39428 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/ISOTOPE DATING
Carbon-14 dating using a tandem, 4:39368 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/MODIFICATIONS
Major improvements at Brookhaven since the beginning, 4:39371 (LA-7445-C)
Proposed upgrading of an EN tandem for heavy ions, 4:39369 (LA-7445-C)
Stony Brook booster project update, 4:39372 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/MOLECULAR IONS
Comments on Coulomb explosion experience at Brookhaven, 4:39399 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/PERFORMANCE
Improved MP acceleration tube performance, 4:39374 (LA-7445-C)
Major improvements at Brookhaven since the beginning, 4:39371 (LA-7445-C)
Status of Laddertron development at HVE, 4:39373 (LA-7445-C)
Thoughts on accelerator tubes, 4:39375 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/TELEMETRY
Telemetry systems: a review and a forecast, 4:39362 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/TRITIUM IONS
Synopsis of tritium running at Penn, 4:39367 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/USES
Carbon-14 dating using a tandem, 4:39368 (LA-7445-C)
VAN DE GRAAFF ACCELERATORS/VACUUM SYSTEMS
Installation of NEC tubes in the Argonne National Laboratory FN, 4:39363 (LA-7445-C)
VANADIUM/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
VANADIUM/NEUTRON REACTIONS
Status of ENDF/B-V neutron emission spectra induced by 14-MeV neutrons (Partial and total spectra, cross sections, graphs), 4:39900 (ORNL/TM-6637)
VANADIUM/X-RAY FLUORESCENCE ANALYSIS
Evaluation of x-ray fluorescence analysis for the determination of arsenic, vanadium, cadmium, lead and mercury in various matrices. Final report, June 1977, 4:39212 (PB-285452)
VANADIUM ALLOYS/CREEP
Strainrange partitioning applied to Ti-6Al-V, 4:39140
VANADIUM ALLOYS/EMBRITTLEMENT
Solid metal embrittlement of Ti-6Al-6V-2Sn by cadmium, silver and gold, 4:39129
VANADIUM ALLOYS/FATIGUE
Strainrange partitioning applied to Ti-6Al-V, 4:39140
VANADIUM ALLOYS/SORPTIVE PROPERTIES
Study on the diffusion of hydrogen into transition metal hydrides and their alloys, 4:39147 (MLM-2600(TR))
VAPORIZATION HEAT/SPECTROMETERS
Heat of vaporization spectrometer, 4:39234
VARIABILITY (GENETIC)
See GENETIC VARIABILITY
VARIABLE STARS/COLOR
Variable star research at Los Alamos, 4:39731 (LA-UR-78-3089)
VARIABLE STARS/HERTZSPRUNG-RUSSELL DIAGRAM
Variable star research at Los Alamos, 4:39731 (LA-UR-78-3089)
VAVILOV-CHERENKOV RADIATION
See CHERENKOV RADIATION
VECTOR MESONS
(Mesons with spin-one.)
VECTOR MESONS/LEPTONIC DECAY
Lepton-width suppression of vector-meson decays, 4:39843
VECTOR MESONS/PARTICLE PRODUCTION
Exclusive vector-meson production in muon-proton scattering, 4:39816
VEGETATION
See PLANTS
VEHICLES
See also AUTOMOBILES
ELECTRIC-POWERED VEHICLES
HYBRID ELECTRIC-POWERED VEHICLES
TRUCKS
VEHICLES/ACCIDENTS
An examination of the effects of the lowered maximum speed limit and fuel shortages in North Carolina. Final report, 1 July 1974-30 June 1977, 4:38938 (PB-284018)
VEHICLES/CATALYTIC CONVERTERS
Catalytic control of NO/sup x/ demonstration. Final report, 4:39088 (PB-284095)
VEHICLES/DESIGN
Second international conference on vehicle structural mechanics. Structural analysis of the vehicle design process, 4:39077
VEHICLES/ENERGY EFFICIENCY
Energy in transport. Volume 1. Data, 4:38941

VEHICLES/EXHAUST GASES
Catalytic control of NO/sup x/ demonstration. Final report, 4:39088 (PB-284095)
Dispersion of pollutants near highways - experimental design and data acquisition procedures. Interim report, September 1975-March 1977, 4:39558 (PB-284866)
VEHICLES/FUEL CONSUMPTION
Energy in transport. Volume 1. Data, 4:38941
VEHICLES/FUEL SYSTEMS
Automated fuel dispensing for state and local governments, 4:39026 (PB-283974)
VEHICLES/MEETINGS
Second international conference on vehicle structural mechanics. Structural analysis of the vehicle design process, 4:39077
VEHICLES/STRESS ANALYSIS
Second international conference on vehicle structural mechanics. Structural analysis of the vehicle design process, 4:39077
VELOCIMETERS/PERFORMANCE
Measuring velocities by laser Doppler interferometry, 4:39508 (UCRL-52000-79-3)
VENTILATION/CONTROL SYSTEMS
Automatic variable ventilation control systems based on air quality detection, 4:39010 (LBL-8893)
VERMONT/ENERGY CONSERVATION
Vermont energy conservation plan, 4:38903 (PB-285508)
VERMONT/ENERGY POLICY
Vermont energy conservation plan, 4:38903 (PB-285508)
VERMONT/GEOCHEMICAL SURVEYS
Savannah River Laboratory hydrogeochemical and stream sediment reconnaissance. Orientation study data release VII, Wolcott, Vermont, area. National Uranium Resource Evaluation Program (Udall Mine), 4:38207 (GJBX-43(79))
VERY HIGH FREQUENCY RADIATION
See RADIOWAVE RADIATION
VERY HIGH PRESSURE/MEASURING METHODS
High temperature science: future needs and anticipated development in high-density shock-wave research, 4:39946 (UCID-18072)
VESSELS (PRESSURE)
See PRESSURE VESSELS
VHF RADIATION
See RADIOWAVE RADIATION
VINYL MONOMERS/QUANTITATIVE CHEMICAL ANALYSIS
FE-NMR analysis of silane hydrogen, phenyl, and vinyl content of several siloxane pre-polymer materials, 4:39200 (MHSMP-79-15)
VISION/BIOLOGICAL RADIATION EFFECTS
Visual phenomena induced by relativistic carbon ions with and without Cerenkov radiation, 4:39666
VOLCANIC REGIONS/MAPS
Geothermal energy in the western United States. Map 1 of the U.S. Geological Survey Circular 790, 4:38514
Geothermal energy in Alaska and Hawaii. Map 2 of U.S. Geological Survey Circular 790, 4:38515
VOLCANIC ROCKS/CHEMICAL ANALYSIS
Obsidian hydration profiles measured by sputter-induced optical emission, 4:39213
VOLTAIC CELLS
See ELECTRIC BATTERIES
VORTICES (MAGNETIC)
See MAGNETIC FLUX
VRAIN REACTOR/TESTING
High-temperature gas-cooled reactor safety studies for the Division of Reactor Safety Research quarterly progress report, October 1-December 31, 1978, 4:38819 (NUREG/CR-0716)
VRAIN REACTOR/TRANSIENTS
Fort St. Vrain Surveillance Program: Transient Analysis Program (TAP) verification, 4:38639 (GA-A-15159)

W

WASHINGTON/WATER RESOURCES
Some political-institutional factors affecting efforts to conserve water in Washington state. Project completion report, 1 October 1976-30 September 1977, 4:38888 (PB-286038)
WASTE BURIAL
See UNDERGROUND DISPOSAL
WASTE DISPOSAL
See also RADIOACTIVE WASTE DISPOSAL
SANITARY LANDFILLS
STACK DISPOSAL
UNDERGROUND DISPOSAL
Impacts of the Resource Conservation and Recovery Act on the siting of coal-conversion energy facilities in the United States, 4:38926 (ORNL/OEPA-12)
WASTE DISPOSAL/GOVERNMENT POLICIES
NATO CCMS pilot study, disposal of hazardous wastes, phase 1. Final report, 4:39048 (PB-286050)
WASTE HEAT UTILIZATION/FEASIBILITY STUDIES
Basic process data on the potential for low level waste heat recovery in the petroleum refining and selected chemical industries of the West South Central United States, 4:39040 (HCP/M5056-02)
WASTE OILS/RECYCLING
Management of environmental risk: a limited integrated assessment of the waste oil refining industry. Final report, 4:38164 (PB-283719)
The use and fate of lubricants, oils, greases, and hydraulic fluids in the iron and steel industry. Final task report, May 1976-April 1978, 4:39561 (PB-284973)
WASTE PROCESSING
See also RADIOACTIVE WASTE PROCESSING
WASTE PROCESSING/FEASIBILITY STUDIES
Reclamation and reuse of fruit processing wastewater, 4:39043 (PB-283694)
WASTE PRODUCT UTILIZATION
See also WASTE HEAT UTILIZATION
A study of the feasibility of utilizing solid wastes for building materials. phase iii and iv summary reports. Final report, September 1975-March 1978, 4:39046 (PB-285437)
WASTE SOLUTIONS
See LIQUID WASTES
WASTE TRANSPORTATION/LEGAL ASPECTS
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL-2457)
WASTE TRANSPORTATION/POLITICAL ASPECTS
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL-2457)
WASTE TRANSPORTATION/SOCIAL IMPACT
Legal, institutional, and political issues in transportation of nuclear materials at the back end of the LWR nuclear fuel cycle, 4:38246 (PNL-2457)
WASTE WATER/SAMPLING
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
WASTE WATER/TOXICITY
Synthetic Fuels Program, 4:38090 (ORNL-5508)
WASTE WATER/WASTE PROCESSING
Assessment of activated carbon for environmental control of trace organics in petroleum refinery wastewater (Granular vs. powdered), 4:38161 (ANL/WR-79-3)
Reclamation and reuse of fruit processing wastewater, 4:39043 (PB-283694)
Water reuse in poultry processing, 4:39044 (PB-283695)
WASTE WATER/WATER TREATMENT
Assessment of environmental characterization activities for the slagging fixed-bed gasification facility at the Grand Forks Energy Research Center, 4:38059 (FE-2496-12)
WATER
See also DRINKING WATER
FEEDWATER
GROUND WATER
SEAWATER
SURFACE WATERS
WATER/ADSORPTION
Interactions of gases with coal: structural inferences, 4:38081 (CONF-790415-26)
WATER/CHEMICAL ANALYSIS
Environmental monitoring near industrial sites: brominated chemicals. Part II: appendix. Final report 19 Jul-16 Dec 77, 4:39202 (PB-286483)
WATER/QUANTITATIVE CHEMICAL ANALYSIS
Computer automation of continuous-flow analyzers for trace constituents in water. Volume 4. Description of program segments. Part 1. TAAIN (Technicon AutoAnalyzer), 4:39203 (UCRL-52532(Vol.4)(Pt.1))
WATER COOLED REACTORS
See also BR-2 REACTOR
BWR TYPE REACTORS
HFIR REACTOR
PWR TYPE REACTORS
SGHWR REACTOR
WATER COOLED REACTORS/FUEL CANS
Preliminary experiment on crack propagation in zircaloy-cladding. Failure behavior of zircaloy-cladding, (1), 4:38807 (JAERI-M-7453)

WATER COOLED REACTORS/FUEL CYCLE
Nondestructive assay instrumentation for thorium oxide-uranium-233 oxide dynamic materials control (DYMAC) application, 4:38297 (WCAP-9344)
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for the period ending December 31, 1977, 4:38237 (WCAP-9293)
Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report for period ending September 30, 1978, 4:38238 (WCAP-9422)
WATER COOLED REACTORS/LOOSE PARTS MONITORING
Loose-parts monitoring: present status of the technology, its implementation in U.S. reactors, and some recommendations for achieving improved performance, 4:38730
WATER COOLED REACTORS/LOSS OF COOLANT
Application of the FLIRA code to fit ERSEC experiments, 4:38792 (CEA-CONF-3999)
WATER COOLED REACTORS/MEMBRANES
Study of reverse osmosis applicability to light water reactor radwaste processing, 4:38253 (NUREG/CR-0724)
WATER COOLED REACTORS/PRESSURE VESSELS
Residual stresses in a weldment of pressure vessel steel, 4:38746
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)
WATER COOLED REACTORS/RADIATION MONITORING
Aims of a measurement program to detect unplanned radioactive discharges from nuclear power stations equipped with light-water reactors, and requirements for the measuring instruments, 4:38828
WATER COOLED REACTORS/REACTOR COOLING SYSTEMS
Outline of the water systems chemistry requirements for a large commercial SGHWR, 4:38658
WATER CURRENT POWER GENERATORS/DESIGN
Current power plant (Patent), 4:38333
WATER POLLUTION/BIOLOGICAL INDICATORS
Chironomid larvae: indicator organisms for discharge of mineral oil and/or heavy metal. A literature survey, 4:39614 (IVL-B-445)
WATER POLLUTION/ENVIRONMENTAL EFFECTS
A program for the environmental assessment of conventional combustion processes. Final task report, March 1977-May 1978, 4:39562 (PB-284974)
WATER POLLUTION/MERCURY
An assessment of mercury emissions from fossil fueled power plants. Final report, 4:39564 (PB-285227)
WATER POLLUTION/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
Environmental monitoring near industrial sites: beta-chloroethers. Final report May 76-Jun 78, 4:39571 (PB-286485)
Sampling and analysis research program at the Paraho shale oil demonstration plant. Final report, January 1976-July 1977, 4:38199 (PB-284027)
WATER POLLUTION CONTROL/POLLUTION CONTROL EQUIPMENT
Future needs and the impact on the water and waste quipment manufacturing industry due to the use of synthetic fuels, 4:38085 (EPA-600/7-78-063)
WATER QUALITY/MONITORING
Water quality/biological surveillance program for CDIF support , 4:38951 (FE-2524-8)
WATER REQUIREMENTS/COST
Planning water supply: cost-rate differentials and plumbing permits. Final report, 4:39052 (PB-285656)
WATER REQUIREMENTS/FORECASTING
The ground water and energy supply situation for Great Plains irrigation, 4:38887 (PB-286002)
The nation's water resources: the Second National Water Assessment. Part III. Functional water uses (1975 and projections to 1985 and 2000), 4:38883 (PB-285749)
WATER REQUIREMENTS/PLANNING
Planning water supply: cost-rate differentials and plumbing permits. Final report, 4:39052 (PB-285656)
WATER RESOURCES
Solar energy, water, and industrial systems in arid lands: technoecological overview and annotated bibliography. Information paper, 4:38358 (PB-285129)
WATER RESOURCES/ALLOCATIONS
Water related constraints in energy production. Final report, 4:38879 (PB-285713)
WATER RESOURCES/AVAILABILITY
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
WATER RESOURCES/EVALUATION
The nation's water resources, the Second National Water Assessment, summary report, 4:38880 (PB-285746)
The nation's water resources: the Second National Water Assessment. Part I. Introduction, 4:38881 (PB-285747)
The nation's water resources: the Second National Water Assessment. Part II. Water management problem profiles, 4:38882 (PB-285748)
The nation's water resources: the Second National Water Assessment. Part III. Functional water uses, 4:38883 (PB-285749)
The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations, 4:38884 (PB-285750)
The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries, 4:38885 (PB-285751)
The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data, 4:38886 (PB-285815)
WATER RESOURCES/GOVERNMENT POLICIES
The nation's water resources: the Second National Water Assessment. Part I. Introduction, 4:38881 (PB-285747)
WATER RESOURCES/MANAGEMENT
Codified and uncodified state laws and agency rules and regulations bearing on water and related land resources in Minnesota. Volume 1, 4:38919 (PB-284103)
WATER RESOURCES/REGIONAL ANALYSIS
The nation's water resources: the Second National Water Assessment. Part IV. Water supply and water quality considerations, 4:38884 (PB-285750)
The nation's water resources: the Second National Water Assessment. Part V. Regional assessment summaries, 4:38885 (PB-285751)
WATER RESOURCES/SOCIO-ECONOMIC FACTORS
The nation's water resources: the Second National Water Assessment. Appendix B. Methodologies and assumptions for socio-economic characteristics and patterns of change and water use and water supply data, 4:38886 (PB-285815)
WATER RESOURCES/WATER QUALITY
Assessment of national consequences of increased coal utilization. Executive summary, 4:38095 (TID-29425(Vol.2))
WATER VAPOR
See also FOG
WATER VAPOR/DIELECTRIC PROPERTIES
Microscopic acceleration physics. I. Discussion of important physical phenomena in the tank insulating gas mixture, 4:39366 (LA-7445-C)
WATER VAPOR/SORPTIVE PROPERTIES
Investigation of the capture of sulfur dioxide and oxygen by condensation of water in droplets. Progress report, September 1, 1977-November 30, 1978, 4:39551 (ORO-5592-2)
WATER WAVES/MEASURING INSTRUMENTS
Preliminary considerations on wave motion measurements. enel's wave meter network, 4:38561
WATERFLOODING/RESEARCH PROGRAMS
Assessment of potential increased oil production by polymer-waterflood in northern and southern mid-continent oil fields. Progress report for the quarter ending December 31, 1978, 4:38141 (DOE/ET-00026-8)
WAVE ENERGY CONVERTERS/DESIGN
Apparatus for extracting energy from wave movement of the sea, 4:38557
Device for deriving power from wave energy (Patent), 4:38560
Wave motor (Patent), 4:38559
Wave power generator (Patent), 4:38558
WAVEGUIDES/BEAM DYNAMICS
Autoacceleration of electron beam and microwave radiation in the diaphragmed waveguide, 4:39387 (CONF-771035-P2)
WAVES (SHOCK)
See SHOCK WAVES
WEATHER/FORECASTING
Effects of mesosclae weather disturbances on contamination concentrations. Fifth technical progress report, 4:39530 (COO-2360-6)
Environmental/resource assessment and information, 4:39531 (DOE/TIC-10043)
Operations of the national weather service, 4:38332 (PB-286739)
WEEDS/RADIONUCLIDE KINETICS
Behavior of technetium and iodine in a Hanford sand and associated subsoil: influence of soil aging on uptake by cheatgrass and tumbleweed, 4:39605 (PNL-2740)
WELDED JOINTS/CRACKS
Crack initiation and growth in welds at 1100°F (593°C), 4:39120 (INIS-mf-4506)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)

WELDED JOINTS/FRACTURE PROPERTIES
Enhancement of the quality of the reactor pressure vessel used in light water power plants by advanced material fabrication and testing technologies, 4:39127 (INIS-mf-4506)
Solid State Division. Progress report for period ending September 30, 1978, 4:38822 (ORNL-5486)
Stable crack growth under sustained load, 4:39123 (INIS-mf-4506)
WELDED JOINTS/NONDESTRUCTIVE TESTING
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
WELDED JOINTS/TENSILE PROPERTIES
Characterization of time-independent properties of formed and welded pipe for breeder reactor applications, 4:38686 (ORNL/TM-6609)
WELDED JOINTS/ULTRASONIC TESTING
Baseline inspection of three transition joint life test articles (LMFBR), 4:38666 (GEFR-00414)
WELDING MACHINES/MODIFICATIONS
Computer automation of an electron-beam welder, 4:39097 (Y/DA-8239)
WELDS
See WELDED JOINTS
WELL CASINGS/PRESSURIZING
Modified calculation of pressures on the casing in sloped boreholes, 4:38153
WELL LOGGING
See also GRAVITY SURVEYS
WELL LOGGING/MEASURING INSTRUMENTS
Technology development for high temperature logging tools, 4:38527 (SAND-79-0013C)
WELL LOGGING EQUIPMENT/INTEGRATED CIRCUITS
Development of integrated thermionic circuits for geothermal high-temperature applications, 4:38525 (LA-UR-79-723)
WHOLE-BODY COUNTERS/DESIGN
Field measurements of radium in the human body (^{226}Ra), 4:39681 (ANL-78-65(Pt.2))
WHOLE-BODY COUNTERS/STANDARDS
National and international standardization of radiation dosimetry. Volume II, 4:39665 (STI/PUB-471(Vol.2))
WIGGLER MAGNETS/BEAM OPTICS
Modeling a horizontal wiggler in an electron storage ring, 4:39480 (SLAC-PUB-2255)
WILD ANIMALS/CONTAMINATION
Human population exposures to mirex and kepone. Criteria document, 4:39566 (PB-285430)
WIND POWER/AVAILABILITY
Status of information for consumers of small wind energy systems, 4:38563 (SERI/TP-51-158)
Wind power climatology of the United States: supplement, 4:38562 (SAND-78-1620)
WIND POWER/BIBLIOGRAPHIES
Solar thermal power generation, 1978. Quarterly reports, 4:38350 (NTISUB/D-451)
WIND POWER/SOCIAL IMPACT
Social assessment of on-site solar energy technologies. Topical report, 4:38366 (HCP/R4040-02)
WIND TURBINES/ECONOMICS
Status of information for consumers of small wind energy systems, 4:38563 (SERI/TP-51-158)
WIND TURBINES/SITE SELECTION
Status of information for consumers of small wind energy systems, 4:38563 (SERI/TP-51-158)
WINDOWS/DESIGN
Comprehensive approach to window design for energy conservation, 4:38458 (CONF-780337-P3)
WINDOWS/HEAT GAIN
Window as a solar collector, 4:38416 (AED-Conf-78-270-002)
WINDOWS/HEAT LOSSES
Window as a solar collector, 4:38416 (AED-Conf-78-270-002)
WINE
See BEVERAGES
WOOD BURNING FURNACES/SOCIAL IMPACT
Social assessment of on-site solar energy technologies. Topical report, 4:38366 (HCP/R4040-02)
WOOD WASTES/GASIFICATION
Conversion of forest residues to a methane-rich gas, 4:38322
WOOL/PROCESSING
Energy use in the New Zealand textile industry, 4:39030
WORKERS
See PERSONNEL
WWER TYPE REACTORS/REACTOR NOISE
Decomposition of noise signals composed of many similar components, 4:38637
WYOMING/ENERGY CONSERVATION
University of Wyoming Energy Symposium, 4:38904 (PB-285510)
WYOMING/ENERGY SOURCE DEVELOPMENT
Characteristics and settlement patterns of energy related operating workers in the Northern Great Plains. Agricultural economics report, 4:38865 (PB-283809)
WYOMING/ENERGY SOURCES
University of Wyoming Energy Symposium, 4:38904 (PB-285510)

X

X RADIATION/COMPARATIVE EVALUATIONS
Comparison of late effects of single x-ray exposure, chronic tritiated water ingestion, and chronic cesium-137 gamma exposure in mice, 4:39667 (BNL-25730)
X RADIATION/REFLECTION
X-ray reflectivity vs mirror surface quality, 4:39960 (UCID-18030)
XENON/CHARGED-PARTICLE TRANSPORT
Total electron-loss cross sections and absolute charge state yields of 20-MeV Fe ions transmitted through gaseous targets, 4:39940
XENON/ELECTRON TRANSFER
Electron transfer in a superdense nondegenerate plasma, 4:39803 (UCRL-Trans-11473)
XENON IONS/ION-MOLECULE COLLISIONS
Charge changing cross sections for heavy ions at energies to 8.5 MeV/amu (Preliminary cross sections, electron pickup and loss, 3.4 to 8.5 MeV/amu), 4:39795 (LBL-8932)
X-RAY GALAXIES/X-RAY SPECTRA
X-ray observations of a flare in NGC4151 from OSO-8, 4:39739 (N-78-31021)
X-RAY RADIOGRAPHY/IMAGES
Method of recording radiographic images (Patent), 4:39329
X-RAY RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY
X-RAY SPECTROMETERS/DESIGN
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
X-RAY SPECTROMETERS/OPERATION
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
X-RAY SPECTROMETERS/PERFORMANCE
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
X-ZERO RESONANCES
See ETA-958 RESONANCES

Y

Y-12 PLANT/SECURITY
Microcomputer-based video motion detection system, 4:38299 (Y/DA-7999)
YEASTS/GENETIC RADIATION EFFECTS
Radiation induced asymmetries in mitotic recombination: evidence for a directional bias in the formation of asymmetric hybrid DNA in yeast, 4:39659 (UR-3490-1568)
YIELD (BIOLOGICAL)
See PRODUCTIVITY
YTTERBIUM ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
YTTERBIUM ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
YTTERBIUM ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
YTTRIUM 89/ENERGY LEVELS
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
YTTRIUM 89 TARGET/PROTON REACTIONS
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
YTTRIUM OXIDES/ELECTRICAL PROPERTIES
Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009-)

Z

ZEA MAYS
See MAIZE
ZEOLITES/CATALYTIC EFFECTS
Reactive intermediates in catalytic methanation, 4:38313 (LBL-8975)
ZERO GRADIENT SYNCHROTRON
See ZGS
ZGS
(12.7-GeV protron synchrotron at Argonne.)
ZGS/POLARIZED BEAMS
Possibility of acceleration of polarized protons in the Brookhaven AGS, 4:39434 (BNL-25734)
ZINC/ADSORPTION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
ZINC/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
ZINC/PRECIPITATION
Attenuation of pollutants in municipal landfill leachate by clay minerals. Final report Dec 72-Aug 75, 4:39598 (PB-287140)
ZINC/PRODUCTION
Energy analysis of zinc production, 4:39034 (PB-283951)
ZINC/TOXICITY
Zinc, 4:39697 (PB-285130)
ZINC 65/TRACER TECHNIQUES
Development of methods to measure the oil consumption of piston engines by means of radionuclide techniques, 4:38304 (KFK-2463)
ZINC ALLOYS/ELECTRONIC STRUCTURE
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ZINC ALLOYS/FORMATION HEAT
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ZINC ALLOYS/LAVES PHASES
Electronic configurations and energies in some thermodynamically correlated laves compounds, 4:39145 (LA-7785-MS)
ZINC-AIR BATTERIES/BATTERY SEPARATORS
Electrochemical zinc-oxygen cell (Patent), 4:38858
Galvanic cell having rechargeable zinc electrode (Patent; mechanical-chemical approach), 4:38853
ZINC-CHLORINE BATTERIES/DESIGN
Operational zinc chlorine battery based on a water store (Patent), 4:38844
ZION STATION UNIT-1
See ZION-1 REACTOR
ZION STATION UNIT-2
See ZION-2 REACTOR
ZION-1 REACTOR/ACTIVITY LEVELS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
ZION-1 REACTOR/CONTAINMENT BUILDINGS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
ZION-2 REACTOR/ACTIVITY LEVELS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
ZION-2 REACTOR/CONTAINMENT BUILDINGS
Gamma dose measurements at Zion and Fort Calhoun Stations, 4:38633 (NUREG/CR-0755)
ZIRCALOY 2/STRESS CORROSION
Preliminary experiment on crack propagation in zircaloy-cladding. Failure behavior of zircaloy-cladding, (1), 4:38807 (JAERI-M-7453)
ZIRCONIUM/CATALYTIC EFFECTS
Catalytic hydrogenation process, 4:39246
ZIRCONIUM/NITRIDATION
Ion nitriding of titanium and zirconium by a dc-glow discharge method (Surface phases), 4:39099
ZIRCONIUM 90/ENERGY LEVELS
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
ZIRCONIUM 90 TARGET/PION MINUS REACTIONS
Pion single charge exchange (Angular distribution, cross sections, preliminary results, 200 MeV), 4:39885 (LA-UR-79-638)
ZIRCONIUM 90 TARGET/PROTON REACTIONS
Elastic and inelastic diffraction scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 4:39907
ZIRCONIUM 94 TARGET/NICKEL 64 REACTIONS
Irregularities in side-feeding patterns, energies, and multipolarities in the ^{154}Er yrast cascade to spin 36, 4:39912
ZIRCONIUM 94 TARGET/OXYGEN 16 REACTIONS
Energy dependence of peripheral reactions induced by heavy ions (Differential cross sections, 140 and 315 MeV, yields), 4:39915
ZIRCONIUM 95/MONITORING
Appendix to Environmental Measurements Laboratory environmental quarterly, 4:39580 (EML-353)
ZIRCONIUM OXIDES/CRYSTAL STRUCTURE
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341-2)
ZIRCONIUM OXIDES/ELECTRICAL PROPERTIES
Development of a high temperature refractory electrode with oxide current leadout (In_2O_3) for the channel of an open-cycle MHD generator based on electrochemical studies of interface boundaries, 4:38978 (CONF-781009-)
ZIRCONIUM OXIDES/ORDER-DISORDER TRANSFORMATIONS
Lattice shear distortions in fluorite structure oxides, 4:39173 (CONF-790341-2)

CONTRACT NUMBER INDEX

Numbers assigned to DOE contracts under which reports announced in this publication were prepared are included in this index.

Contract No.	*Abstract No.*	*Report No.*
AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
	4:38252	MLM—2595
	4:38292	MLM—2603
AC04-76DP00487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
	4:39517	MHSMP—79-8
AC04-76DP00789	**Sandia Labs., Albuquerque, NM (USA)**	
	4:38078	SAND—79-0505
	4:38145	SAND—79-0562
	4:38295	SAND—79-0186
	4:38562	SAND—78-1620
	4:38847	SAND—78-1364
	4:39095	SAND—79-0922C
	4:39191	SAND—78-1198
	4:39726	SAND—78-7076
	4:39810	SAND—79-0382
ACO4-76DP00789	**Sandia Labs., Albuquerque, NM (USA)**	
	4:39727	SAND—79-0115
EC-77-A-31-1034	**Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center**	
	4:38836	DOE/NASA/0038—79/1
EC-77-C-01-2165	**League of Women Voters Education Fund, Washington, DC (USA)**	
	4:38902	HCP/M—2165
EC-77-C-02-4338	**Bodenheimer (B.A.) and Co., Inc., Stamford, CT (USA)**	
	4:39020	COO—4338-4
EC-77-C-03-1543	**Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.**	
	4:38592	SAN—1543-12
EC-77-S-02-4206	**Purdue Univ., Lafayette, IN (USA). Energy Systems Simulation Lab.**	
	4:38610	COO—4206-5
EE-77-S-05-5592	**Georgia Inst. of Tech., Atlanta (USA)**	
	4:39551	ORO—5592-2
EF-76-C-05-5301	**Pennzoil Co., Vienna, WV (USA)**	
	4:38142	ORO—5301-34
EF-77-A-01-2893	**Exxon Research and Engineering Co., Florham Park, NJ (USA)**	
	4:38077	FE—2893-16
EF-77-C-01-2621	**International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center**	
	4:38061	FE—2621-3
EF-77-C-01-2709	**Airco Cryogenics, Irvine, CA (USA)**	
	4:38046	ACD—38391-12
EF-77-C-01-2781	**Atomics International Div., Canoga Park, CA (USA). Energy Systems Group**	
	4:38076	FE—2781-3
EF-77-S-01-2666	**Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering**	
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EF-77-S-01-2721	**West Virginia Univ., Morgantown (USA). Coal Research Bureau**	
	4:38086	FE—2721-2
EF-77-S-01-2722	**West Virginia Univ., Morgantown (USA). Coal Research Bureau**	
	4:38118	FE—2722-3
EF-77-S-02-4227	**Chicago Univ., IL (USA)**	
	4:38083	COO—4227-6
EF-77-S-02-4324	**Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering**	
	4:38072	COO—4324-T1
EF-77-S-05-5603	**University of Southern Mississippi, Hattiesburg (USA). Dept. of Polymer Science**	
	4:39235	BETC—5603-5
	4:39236	BETC—5603-6
EG-77-A-36-1021	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	4:38528	HCP/T1021—36
EG-77-C-01-4042	**Solar Energy Research Inst., Golden, CO (USA)**	
	4:38309	SERI/TR—33-122
	4:39352	SERI/SP—11-142
	4:38353	SERI/TR—51-161
	4:38361	SERI/TR—51-160
	4:38362	SERI/TR—51-162
	4:38367	SERI/TP—53-123
	4:38368	SERI/TR—62-148
	4:38481	SERI—22
	4:38563	SERI/TP—51-158
	4:39090	SERI/SP—33-140
EG-77-C-01-4113	**AIA Research Corp., Washington, DC (USA)**	
	4:38466	HCP/CS—4113-2
	4:38467	HCP/CS—4113-3
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EG-77-C-02-4274	**Sanders Associates, Inc., Nashua, NH (USA). Defensive Systems Div.**	
	4:38485	COO—4274-1
EG-77-C-02-4300	**Sea Solar Power, Inc., York, PA (USA)**	
	4:38412	COO—4300-7
EG-77-C-03-1608	**Public Service Co. of New Mexico, Albuquerque (USA)**	
	4:38409	SAN—1608-4-2
EG-77-G-01-4040	**Department of Energy, Washington, DC (USA). Office of Energy Research**	
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EG-77-S-02-4257	**Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy**	
	4:39978	COO—4257-3
EG-77-S-02-4517	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
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EG-77-S-02-4523	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
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EG-77-S-02-4546	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
	4:38370	COO—4546-5
EG-77-S-02-4577	**Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.**	
	4:38397	COO—4577-5
EM-75-F-01-8073	**RAND Corp., Santa Monica, CA (USA)**	
	4:38932	RAND/R—2278-DWP/NSF
EM-76-C-01-8630	**Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center**	
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EM-77-C-01-5056	**Mechanical Technology, Inc., Latham, NY (USA)**	
	4:39040	HCP/M5056—02

Contract No.	Abstract No.	Report No.
EM-77-C-01-8962	Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications	
	4:38899	DOE/TIC—10062
	4:38900	DOE/TIC—10065
	4:38901	DOE/TIC—10066
	4:39008	DOE/TIC—10064
EM-78-C-01-4228	Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications	
	4:38417	CONF-780337—P1
	4:38429	CONF-780337—P2
	4:38451	CONF-780337—P3
EN-77-C-06-1058-001	Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)	
	4:38233	WCAP—9189
	4:38235	WCAP—9278
	4:38236	WCAP—9282
	4:38237	WCAP—9293
	4:38238	WCAP—9422
	4:38297	WCAP—9344
	4:38298	WCAP—9345
EN-77-C-06-1085-001	Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)	
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ET-76-G-01-9005	Alabama Univ., University (USA). Mineral Resources Inst.	
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ET-77-C-03-1791	Talley Energy Systems, Inc., Scottsdale, AZ (USA)	
	4:38193	TID—28955
	4:38194	TID—28958
ET-78-C-01-2765	Department of Energy, Washington, DC (USA)	
	4:38062	FE—2765-T1
ET-78-C-01-2806	Institute of Gas Technology, Chicago, IL (USA)	
	4:38063	FE—2806-1
ET-78-C-01-2858	Systems Control, Inc., Palo Alto, CA (USA)	
	4:38870	TID—29393
ET-78-C-02-4710	Wisconsin Univ., Madison (USA)	
	4:39966	UWFDM—227
ET-78-C-03-2180	Gary Operating Co., Englewood, CO (USA)	
	4:38140	BETC—2180-4
ET-78-C-07-1702	Westinghouse Electric Corp., Boulder, CO (USA)	
	4:39505	IDO—1702-T1
ET-78-F-03-1747	Equity Oil Co., Salt Lake City, UT (USA)	
	4:38190	FE—1747-1
ET-78-S-02-4410	Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering	
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ET-78-S-02-4933	Rensselaer Polytechnic Inst., Troy, NY (USA). Gaerttner LINAC Lab.	
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ET-78-S-02-5014	Wisconsin Univ., Madison (USA)	
	4:38619	COO—5014-3
EV-78-C-01-6458	Market Facts, Inc., Washington, DC (USA)	
	4:38365	DOE/TIC—10016
EW-76-C-15-0003	General Electric Co., Sunnyvale, CA (USA)	
	4:38667	GEFR-SP—151
EW-76-C-15-2395	General Electric Co., Sunnyvale, CA (USA)	
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EW-78-C-02-4702	Suntek Research Associates, Corte Madera, CA (USA)	
	4:38505	COO—4702-3
EW-78-C-19-0007	Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center	
	4:38139	BETC—0007-3
EW-78-C-19-0026	Gruy Federal, Inc., Houston, TX (USA)	
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EW-78-S-02-4748	Industrial Health Foundation, Inc., Pittsburgh, PA (USA)	
	4:38043	COO—4748-1
EW-78-S-19-0001	Texas Univ., Austin (USA)	
	4:38138	BETC—0001-1
EX-76-A-01-2295-037	Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.	
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EX-76-A-29-1037	Sunkeeper Control Corp., Andover, MA (USA)	
	4:38462	DOE/NASA/CR—161151
	4:38463	DOE/NASA/CR—161190
	4:38464	DOE/NASA/CR—161192
	4:38488	DOE/NASA/CR—161166
	4:38489	DOE/NASA/TM—78219
	4:38490	DOE/NASA/TM—78223
	4:38491	DOE/NASA/TM—78225
EX-76-C-01-0496	Washington State Univ., Pullman (USA)	
	4:38073	FE—0496-T14
EX-76-C-01-1207	Bituminous Coal Research, Inc., Monroeville, PA (USA)	
	4:38049	FE—1207-49
	4:38050	FE—1207-53
EX-76-C-01-1760	Tennessee Univ., Tullahoma (USA). Space Inst.	
	4:38957	FE—1760-29
EX-76-C-01-1775	Parsons (Ralph M.) Co., Pasadena, CA (USA)	
	4:38051	FE—1775-18
	4:38052	FE—1775-21
EX-76-C-01-1784	Metal Properties Council, Inc., New York (USA)	
	4:38053	FE—1784-42
EX-76-C-01-1793	Foster-Miller Associates, Inc., Waltham, MA (USA)	
	4:38054	FE—1793-46
EX-76-C-01-1806	General Electric Co., Schenectady, NY (USA). Gas Turbine Div.	
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EX-76-C-01-2006	Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering	
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EX-76-C-01-2047	Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering	
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EX-76-C-01-2090	Systems Control, Inc., Palo Alto, CA (USA)	
	4:38864	TID—29389
	4:38870	TID—29393
EX-76-C-01-2098	Mueller Associates, Inc., Baltimore, MD (USA)	
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EX-76-C-01-2229	Kentucky Univ., Lexington (USA)	
	4:38056	FE—2229-10
	4:38057	FE—2229-11
EX-76-C-01-2295	Massachusetts Inst. of Tech., Cambridge (USA)	
	4:38080	FE-MIT—2295T26-6
EX-76-C-01-2307	Institute of Gas Technology, Chicago, IL (USA)	
	4:38075	FE—2307-38
EX-76-C-01-2346	Dow Chemical Co., Midland, MI (USA)	
	4:38191	FE—2346-34
EX-76-C-01-2369	Exxon Research and Engineering Co., Baytown, TX (USA)	
	4:38058	FE—2369-20
EX-76-C-01-2453	Mitre Corp., McLean, VA (USA). METREK Div.	
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EX-76-C-01-2461	Georgetown Univ., Washington, DC (USA)	
	4:38124	HCP/T2461—10
EX-76-C-01-2489	Institute of Gas Technology, Chicago, IL (USA)	
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EX-76-S-01-2496	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Environmental Studies Inst.	
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EX-77-A-01-2295	Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.	
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EY-76-A-09-0870	Forest Service, Athens, GA (USA). Southeastern Forest Experiment Station	
	4:39658	SRO—0870-5
EY-76-C-01-2113	Hittman Associates, Inc., Columbia, MD (USA)	
	4:39009	HIT—687
EY-76-C-02-0016	Brookhaven National Lab., Upton, NY (USA)	
	4:38301	BNL—25634
	4:38601	BNL—25587
	4:38791	BNL-NUREG—25714
	4:38812	

Contract No.	Abstract No.	Report No.
		NUREG/CR—0513
	4:38860	BNL—25933
	4:39269	BNL—50961
	4:39380	BNL—25788
	4:39429	BNL—25784
	4:39433	BNL—25311
	4:39434	BNL—25734
	4:39435	BNL—25795
	4:39436	BNL—25796
	4:39437	BNL—25797
	4:39438	BNL—25880
	4:39466	BNL—25733
	4:39467	BNL—25755
	4:39468	BNL—25774
	4:39469	BNL—25783
	4:39470	BNL—25793
	4:39471	BNL—25798
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	4:39473	BNL—25822
	4:39474	BNL—25857
	4:39528	BNL—25026
	4:39540	BNL—25002
	4:39612	BNL—25114
	4:39667	BNL—25730
	4:39692	BNL—25910
	4:39819	BNL—24848
	4:39822	BNL—25879
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EY-76-C-02-0038		Notre Dame Univ., IN (USA). Radiation Lab.
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EY-76-C-02-1545		Ohio State Univ., Columbus (USA). Dept. of Physics
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EY-76-C-02-2232		Rockefeller Univ., New York (USA). Dept. of Physics
	4:39814	COO—2232A-78
	4:39823	COO—2232A-67
	4:39824	COO—2232A-68
EY-76-C-02-2630		Ford Motor Co., Dearborn, MI (USA)
	4:39073	AMMRC-TR—79-11
EY-76-C-02-3000		Fermi National Accelerator Lab., Batavia, IL (USA)
	4:39853	FERMILAB-CONF—78/37-THY
	4:39861	FERMILAB-Conf—78/73-THY
EY-76-C-02-3071		Pennsylvania State Univ., University Park (USA). Dept. of Physics
	4:39820	COO—3071-237
EY-76-C-02-3073		Princeton Univ., NJ (USA). Plasma Physics Lab.
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	4:39980	PPPL—1534
	4:40006	PPPL—1537
	4:40008	PPPL—1517
	4:40020	PPPL—1521
EY-76-C-02-3077		New York Univ., NY (USA). Courant Mathematics and Computing Lab.
	4:40032	COO—3077-156
EY-76-C-02-3490		Rochester Univ., NY (USA)
	4:39244	UR—3490-1573
	4:39245	UR—3490-1574
	4:39637	UR—3490-1569
	4:39638	UR—3490-1578
	4:39649	UR—3490-1480
	4:39650	UR—3490-1553
	4:39659	UR—3490-1568
EY-76-C-02-4066		Exxon Nuclear Co., Inc., Richland, WA (USA)
	4:38624	COO—4066-9
EY-76-C-03-0012		California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology
	4:39595	UCLA—12-1190
EY-76-C-03-0167-065		General Atomic Co., San Diego, CA (USA)
	4:38639	GA-A—15159
	4:38799	GA-A—14546
EY-76-C-03-0511		Wisconsin Univ., Madison (USA). Dept. of Physics
	4:39835	UH—511-330-79
	4:39872	UH—511-329-79
EY-76-C-03-0515		Stanford Linear Accelerator Center, CA (USA)
	4:39462	SLAC-PUB—2266
	4:39480	SLAC-PUB—2255
	4:39481	SLAC-PUB—2258
	4:39482	SLAC-PUB—2262
	4:39483	SLAC-PUB—2265
	4:39484	SLAC-PUB—2267
	4:39485	SLAC-PUB—2270
	4:39815	SLAC-PUB—2218
	4:39856	SLAC-PUB—2298
EY-76-C-03-0824-028		Atomics International Div., Canoga Park, CA (USA)
	4:38798	ESG-DOE—13254
EY-76-C-03-0893-030		General Electric Co., Sunnyvale, CA (USA)
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EY-76-C-03-0893-032		General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.
	4:38800	GEFR—00415
EY-76-C-03-1137		San Diego Gas and Electric Co., CA (USA)
	4:38540	SAN—1137-11
	4:38543	SAN—1137-10
EY-76-C-03-1189		Cities Service Co., Jackson, MS (USA)
	4:38144	SAN—1189-3
EY-76-C-03-1226		Hittman Associates, Inc., Columbia, MD (USA)
	4:38993	HIT—689
	4:39004	HIT—691
	4:39013	HIT—690
	4:39014	HIT—692
EY-76-C-03-1265		Stanford Univ., CA (USA). Petroleum Research Inst.
	4:38133	SAN—1265-8
EY-76-C-03-1286		RCA Labs., Princeton, NJ (USA)
	4:38392	SAN—1286-4
EY-76-C-04-0053		Mound Facility, Miamisburg, OH (USA)
	4:38492	MLM—2606(OP)
	4:38506	MLM—2598(OP)
EY-76-C-04-0487		Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)
	4:39200	MHSMP—79-15
	4:40040	MHSMP—79-42
EY-76-C-04-0515		Stanford Linear Accelerator Center, CA (USA)
	4:39711	SLAC-TN—79-1
EY-76-C-04-0613		Bendix Corp., Kansas City, MO (USA)
	4:39101	BDX—613-2165
	4:39331	BDX—613-2173
EY-76-C-04-0789		Sandia Labs., Albuquerque, NM (USA)
	4:38180	SAND—79-0056
	4:38189	SAND—78-2268C
	4:38192	SAND—79-0746C
	4:38294	SAND—78-0400
	4:38480	SAND—78-0681
	4:38496	SAND—76-0347
	4:38497	SAND—78-0977
	4:38498	SAND—78-0982
	4:38499	SAND—78-1769
	4:38500	SAND—78-7034
	4:38501	SAND—79-0515
	4:38507	SAND—79-0246C
	4:38527	SAND—79-0013C
	4:38564	SAND—79-0431
	4:38614	SAND—79-0396C
	4:38823	SAND—78-0261C
	4:38824	SAND—78-2074C
	4:39093	SAND—79-0352C
	4:39094	SAND—79-0727C
	4:39128	SAND—79-0636C
	4:39168	SAND—79-0497C
	4:39177	SAND—79-2076C
	4:39179	SAND—79-0413C
	4:39260	SAND—79-0329
	4:39279	SAND—78-1584C
	4:39326	SAND—78-8047
	4:39338	SAND—78-1523C
	4:39339	SAND—78-1859C
	4:39340	SAND—79-0388C
	4:39461	SAND—79-0596C
	4:39507	SAND—78-1342
	4:39518	SAND—78-1731C
	4:39519	SAND—79-0027
	4:39704	SAND—79-0240
	4:39705	SAND—79-0796
	4:40029	SAND—78-2242
	4:40042	SAND—79-0458C

Contract No.	Abstract No.	Report No.
EY-76-C-04-3533	Atomics International Div., Golden, CO (USA). Rocky Flats Plant	
	4:38241	RFP—2886
	4:38242	RFP—2887
	4:38257	RFP—2835
	4:40041	RFP—2902
EY-76-C-05-0033	Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis	
	4:38917	ORAU/IEA—79-5(0)
EY-76-C-05-4893	DSS Engineers, Inc., Fort Lauderdale, FL (USA)	
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EY-76-C-05-5194	West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography	
	4:38177	ORO—5194-2(Vol.1)
EY-76-C-06-1570	Idaho National Engineering Lab., Idaho Falls (USA)	
	4:38796	CONF-790602—2
EY-76-C-06-1830	Battelle Human Affairs Research Center, Seattle, WA (USA)	
	4:38246	PNL—2457
	4:38255	PNL—2690
	4:38256	PNL—2809
	4:38271	PNL—1948
	4:38408	PNL—2810
	4:38624	COO—4066-9
	4:38750	NUREG/CR—0220
	4:38912	PNL—2410-1(Rev.)
	4:38971	PNL—2738
	4:39029	RLO—1830-T1
	4:39167	PNL—2805
	4:39572	PNL—2829
	4:39605	PNL—2740
	4:39606	BNWL-SA—6532
EY-76-C-06-1857	United Nuclear Industries, Inc., Richland, WA (USA)	
	4:38785	UNI—1197
EY-76-C-07-1540	Energy, Inc., Idaho Falls, ID (USA)	
	4:38243	IDO—1540-T1
EY-76-C-07-1570	Idaho National Engineering Lab., Idaho Falls (USA)	
	4:38248	CONF-790602—30
	4:38262	CONF-790602—25
	4:38289	CONF-790430—2
	4:38530	TREE—1340
	4:38795	CONF-790423—3
	4:38797	CONF-790602—3
	4:38825	TFBP-TR—279
	4:39910	CONF-790602—41
EY-76-C-09-0001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	4:39492	DP—1501
	4:39613	DP—1512
	4:39707	DP-MS—79-11
EY-76-C-13-1664	Idaho Univ., Moscow (USA). Dept. of Geology	
	4:38206	GJBX—33(79)
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	4:38208	GJBX—48(79)(Vol.2)(Atlin)
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	4:38210	GJBX—48(79)(Vol.2)(Craig)
	4:38211	GJBX—48(79)(Vol.2)(Juneau)
	4:38212	GJBX—48(79)(Vol.2)(Ketchikan)
	4:38213	GJBX—48(79)(Vol.2)(Petersburg)
	4:38214	GJBX—48(79)(Vol.2)(Sitka)
	4:38215	GJBX—48(79)(Vol.2)(Skagway)
	4:38216	GJBX—48(79)(Vol.2)(Sumdum)
	4:38217	GJBX—57(79)(Vol.2)(Charlotte)
	4:38218	GJBX—57(79)(Vol.2)(Knoxville)
	4:38219	GJBX—59(79)(Vol.2)(Prescott)
	4:38220	GJBX—59(79)(Vol.2)(Williams)
EY-76-C-14-2170	Hanford Engineering Development Lab., Richland, WA (USA)	
	4:38668	HEDL-SA—1329
	4:38669	HEDL-SA—1535-FP
	4:38671	HEDL-SA—1543-FP
	4:38672	HEDL-SA—1683-FP
	4:38673	HEDL-TME—78-93
	4:38700	HEDL-TI—75002-33
	4:38701	HEDL-TI—75002-34
	4:38754	HEDL-TME—78-103
	4:38778	HEDL-SA—1671
	4:40013	HEDL-SA—1594-FP
EY-76-C-15-2395	Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Reactors Div.	
	4:39958	CONF-790608—1
EY-76-S-02-1199	Illinois State Water Survey, Urbana (USA)	
	4:39541	COO—1199-54
EY-76-S-02-2003	Michigan Univ., Ann Arbor (USA). Great Lakes Research Div.	
	4:39608	COO—2003-T1
EY-76-S-02-2012	Oakland Univ., Rochester, MI (USA). Inst. of Biological Sciences	
	4:39668	COO—2012-38
EY-76-S-02-2197	Wyoming Univ., Laramie (USA)	
	4:39829	COO—2197-63
EY-76-S-02-2245	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering	
	4:38663	COO—2245-65
	4:38664	COO—2245-66
EY-76-S-02-2250	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering	
	4:38665	COO—2250-35
EY-76-S-02-2280	Northwestern Univ., Evanston, IL (USA)	
	4:40030	COO—2280-37
EY-76-S-02-2307	Cincinnati Univ., OH (USA). Dept. of Biological Sciences	
	4:39607	DOE/EV—2307-15
EY-76-S-02-2360	Drexel Univ., Philadelphia, PA (USA)	
	4:39530	COO—2360-6
EY-76-S-02-2383	Illinois Univ., Urbana (USA). Dept. of Computer Science	
	4:40031	COO—2383-0056
EY-76-S-02-2456	Columbia Univ., New York (USA)	
	4:39971	COO—2456-76
EY-76-S-02-2534	Massachusetts Inst. of Tech., Cambridge (USA)	
	4:38520	COO—2534-4
EY-76-S-02-2640	Minnesota Univ., Minneapolis (USA)	
	4:39790	COO—2640-10
EY-76-S-02-2718	Missouri Univ., St. Louis (USA)	
	4:39791	COO—2718-7
EY-76-S-02-2874	Columbia Univ., New York (USA). School of Public Health	
	4:39696	COO—2874-46
EY-76-S-02-2960	Connecticut Univ., Storrs (USA). Inst. of Materials Science	
	4:39091	COO—2960-3
EY-76-S-02-3235	Brown Univ., Providence, RI (USA). Dept. of Physics	
	4:39931	COO—3235-85
EY-76-S-02-3496	Rochester Univ., NY (USA)	
	4:39932	COO—3496-70
EY-76-S-02-4018	Colorado State Univ., Fort Collins (USA)	
	4:38200	COO—4018-3
EY-76-S-02-4051	Brown Univ., Providence, RI (USA). Div. of Engineering	
	4:38531	COO—4051-25
	4:38532	COO—4051-27
	4:38533	COO—4051-40
	4:38534	COO—4051-41
	4:38538	COO—4051-34
	4:38539	COO—4051-38
	4:38541	COO—4051-35
EY-76-S-03-0034	California Univ., Los Angeles (USA). Inst. of Geophysics	
	4:38121	SAI—068-79-516
EY-76-S-03-0034-254	California Univ., Los Angeles (USA). Dept. of Materials	
	4:38068	TID—29304
EY-76-S-03-0034-269	California Univ., Berkeley (USA). Coll. of Engineering	
	4:38826	UCB/EERC—79/08
EY-76-S-03-0326-030	Stanford Univ., CA (USA). Dept. of Computer Science	
	4:40043	SU—326-P30-61

Contract No.	Abstract No.	Report No.
EY-76-S-05-4398	**Florida Univ., Gainesville (USA)**	
	4:38861	DOE/TIC—10108
EY-76-S-05-5126	**Maryland Univ., College Park (USA). Dept. of Physics and Astronomy**	
	4:39918	ORO—5126-62
EY-76-S-06-2225-027	**Washington Univ., Seattle (USA). Dept. of Oceanography**	
	4:39611	DOE/EV—75027-58
EY-76-S-06-2227-025	**Oregon State Univ., Corvallis (USA)**	
	4:39657	PNL-RAP—33
EY-76-S-06-2230-004	**SEE ALSO- 5677710 Science Research Council, Chilton (UK). Rutherford High Energy Lab.**	
	4:39852	DOE/ER/70004—207
	4:39858	DOE/ER/70004—218
EY-77-C-06-1030	**Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations**	
	4:38247	RHO-CD—271
	4:38272	RHO-BWI—79-100-1Q
EY-77-C-09-0945-001	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.**	
	4:38228	WCAP—9104
	4:38229	WCAP—9104(Add.1)
	4:38230	WCAP—9104(Add.2)
EY-77-C-09-0945-004	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.**	
	4:38231	WCAP—9104(Add.3)
EY-77-C-09-0945-005	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.**	
	4:38296	WCAP—9128
EY-77-C-09-0945-007	**Westinghouse Nuclear Energy Systems, Pittsburgh, PA (USA)**	
	4:38232	WCAP—9144
EY-C-14-2170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
	4:38670	HEDL-SA—1536-FP
NAS-7-100-954527	**Springborn Labs., Inc., Enfield, CT (USA)**	
	4:38371	DOE/JPL/954527—7
NAS-7-100-954853	**Spectrolab, Inc., Sylmar, CA (USA)**	
	4:38372	DOE/JPL/954853—3
	4:38373	DOE/JPL/954853—4
NAS-7-100-954862	**Aerochem Research Labs., Inc., Princeton, NJ (USA)**	
	4:38398	DOE/JPL/954862—4
NAS-7-100-954865	**Sensor Technology, Inc., Chatsworth, CA (USA)**	
	4:38374	DOE/JPL/954865—3
NAS-7-100-954887	**Texas Instruments, Inc., Dallas (USA)**	
	4:38375	DOE/JPL/954887—4
NAS-7-100-954888	**Kayex Corp., Rochester, NY (USA)**	
	4:38376	DOE/JPL/954888—3
W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
	4:38161	ANL/WR—79-3
	4:38410	ANL/OTEC—001
	4:38411	ANL/OTEC-TM—1
	4:38524	LA—7693-MS
	4:38661	ANL—78-99
	4:38662	ANL-CT—79-16
	4:38684	NUREG/CR—0001
	4:38685	NUREG/CR—0785
	4:38790	ANL—78-103
	4:38897	CONF-781213—6
	4:38909	ANL/EES-TM—40
	4:38958	CONF-780952—24
	4:39003	CONF-7809138—1
	4:39173	CONF-790341—2
	4:39174	CONF-790341—3
	4:39175	CONF-790341—4
	4:39268	ANL/FPP/TM—118
	4:39445	DOE/TIC—10045
	4:39529	CONF-790101—6
	4:39539	ANL/RER—78-2
	4:39670	ANL—78-65(Pt.2)
	4:39909	ANL/NDM—46
	4:40034	DOE/TIC—10096
	4:40049	DOE/TIC—10097
W-7405-ENG-26	**Oak Ridge National Lab., TN (USA)**	
	4:38047	CONF-790405—12
	4:38048	CONF-790405—14
	4:38071	CONF-790415—25
	4:38081	CONF-790415—26
	4:38082	CONF-790418—4
	4:38130	CONF-790415—31
	4:38222	K/UR—21(Pt.2)
	4:38226	ORNL/TM—6665
	4:38227	ORNL/TM—6746
	4:38240	ORNL/TM—6672
	4:38249	CONF-790331—4
	4:38250	CONF-790420—9
	4:38254	ORNL/TM—6573
	4:38260	CONF-790331—2
	4:38261	CONF-790331—3
	4:38290	K/OA—4488
	4:38299	Y/DA—7999
	4:38302	ORNL/TM—6660
	4:38631	CONF-790313—4
	4:38642	ORNL/TM—6478
	4:38686	ORNL/TM—6609
	4:38687	ORNL/TM—6688
	4:38717	ORNL/TM—6821
	4:38794	CONF-790340—1
	4:38819	NUREG/CR—0716
	4:38822	ORNL—5486
	4:38837	ORNL/TM—6701
	4:38838	ORNL/TM—6936
	4:38875	CONF-790331—1
	4:38926	ORNL/OEPA—12
	4:38992	CONF-790446—4
	4:39028	CONF-781244—1
	4:39039	CONF-790443—2
	4:39049	Y/DA—8220
	4:39092	ORNL/TM—6711
	4:39097	Y/DA—8239
	4:39102	CONF-790341—1(Draft)
	4:39106	CONF-790343—1
	4:39181	CONF-790415—24
	4:39196	CONF-781121—22
	4:39214	CONF-790330—1
	4:39215	ORNL/TM—6670
	4:39253	CONF-790415—21
	4:39259	ORNL/TM—6855
	4:39263	Y—2180
	4:39360	CONF-780622—30
	4:39426	CONF-790327—10
	4:39441	CONF-790327—3
	4:39442	CONF-790327—8
	4:39443	CONF-790327—9
	4:39460	ORNL/TM—6828
	4:39510	Y/DA—7109
	4:39581	ORNL—5508
	4:39601	CONF-781105—100
	4:39783	CONF-790344—1
	4:39789	CONF-790438—1
	4:39900	ORNL/TM—6637
	4:39945	CONF-790342—1
	4:39979	ORNL/TM—6823
	4:40010	ORNL/TM—6560
	4:40035	K/CSD/TM—29
	4:40050	CONF-790146—1
W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	4:38128	LA—6915-MS
	4:38188	LA-UR—79-646
	4:38202	LA—7697
	4:38239	LA—7645-MS
	4:38291	LA—7717-M
	4:38519	LA-UR—79-665
	4:38525	LA-UR—79-723
	4:38547	LA-UR—79-670
	4:38548	LA-UR—79-683
	4:38621	LA—7635-MS
	4:38622	LA—7707-PR
	4:38641	LA—7709-T
	4:38724	LA—7704-PR
	4:38813	NUREG/CR—0561
	4:39145	LA—7785-MS
	4:39221	LA—7602-MS
	4:39237	LA—7542
	4:39258	LA-UR—79-332
	4:39270	LA—7639-MS
	4:39288	LA—7783-MS
	4:39289	LA-UR—79-675
	4:39359	LA—7445-C
	4:39377	

Contract No.	Abstract No.	Report No.
		LA—7650-PR
	4:39400	LA-UR—79-676
	4:39401	LA-UR—79-695
	4:39402	LA-UR—79-699
	4:39403	LA-UR—79-701
	4:39404	LA-UR—79-709
	4:39405	LA-UR—79-710
	4:39406	LA-UR—79-750
	4:39407	LA-UR—79-751
	4:39408	LA-UR—657
	4:39432	LA-UR—79-703
	4:39446	LA-UR—79-463
	4:39447	LA-UR—79-651
	4:39448	LA-UR—79-658
	4:39449	LA-UR—79-685
	4:39450	LA-UR—79-688
	4:39451	LA-UR—79-689
	4:39452	LA-UR—79-705
	4:39453	LA-UR—79-714
	4:39454	LA-UR—79-898
	4:39516	LA—7817-MS(Vol.2)
	4:39731	LA-UR—78-3089
	4:39738	LA-UR—79-309
	4:39793	LA—7727-T
	4:39802	LA-UR—79-218
	4:39813	LA—7691-PR
	4:39831	LA-UR—79-653
	4:39832	LA-UR—79-893
	4:39841	LA-UR—79-357
	4:39863	LA-UR—79-361
	4:39878	LA—7663-MS
	4:39879	LA—7722-PR
	4:39885	LA-UR—79-638
	4:39903	LA-UR—79-839
	4:39922	LA-UR—78-3062
	4:39938	LA-UR—79-533
	4:40001	LA—7686-MS
	4:40009	LA—7759-MS
	4:40036	LA—7633-M
	4:40037	LA—7677-MS
	4:40038	LA—7700-MS
	4:40039	/522
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	4:38181	UCRL—50036-78-4
	4:38182	UCRL—81707
	4:38273	UCID—18101
	4:38274	UCID—18103
	4:38275	UCRL—50050-78
	4:38407	LBL—7841
	4:38470	LBL—7811
	4:38471	LBL—8814
	4:38512	LBL—8802
	4:38518	LBL—7076
	4:38526	LBL—8675
	4:38545	UCRL—52640
	4:38546	LBL—7091
	4:38634	UCID—17958
	4:38821	NUREG/CR—0746
	4:38827	UCRL—52708
	4:38859	UCRL—13970
	4:38995	LBL—8892
	4:39010	LBL—8893
	4:39096	UCRL—82528
	4:39103	UCRL—81879
	4:39169	UCRL—82159
	4:39182	UCRL—52434(Vol.4)
	4:39187	UCID—18077
	4:39203	UCRL—52532(Vol.4)(Pt.1)
	4:39204	UCRL—52594
	4:39210	UCID—18151
	4:39238	LBL—8975
	4:39254	LBL—8548
	4:39255	UCRL—82181
	4:39261	UCID—18160
	4:39262	UCID—18170
	4:39293	UCRL—52000-79-3
	4:39327	UCRL—82436
	4:39423	UCRL—81834
	4:39457	LBL—8808
	4:39458	LBL—8818
	4:39459	

Contract No.	Abstract No.	Report No.
		LBL—8947
	4:39475	LBL—7574
	4:39479	LBL—8887
	4:39494	LBL—7294
	4:39498	UCRL—52657
	4:39509	UCRL—82358
	4:39520	UCID—18165
	4:39533	UCRL—82542
	4:39544	LBL—7284
	4:39545	LBL—7999
	4:39573	UCRL—82549
	4:39582	UCRL—52669
	4:39702	LBL—9085
	4:39706	UCRL—52681
	4:39714	UCRL—52665
	4:39725	LBL—7038
	4:39736	UCRL—82057(Rev.1)
	4:39772	LBL—7687
	4:39773	UCRL—13950
	4:39784	LBL—8208
	4:39794	LBL—7686
	4:39795	LBL—8932
	4:39796	UCRL—13965
	4:39803	UCRL-Trans—11473
	4:39806	UCID—18161
	4:39834	LBL—8936
	4:39865	LBL—8561
	4:39887	LBL—8463
	4:39914	LBL—8613
	4:39923	UCRL—81909
	4:39934	LBL—8758
	4:39942	M—100
	4:39946	UCID—18072
	4:39948	UCRL-Trans—11471
	4:39960	UCID—18030
	4:39962	UCRL—52667
	4:39974	UCID—18089
	4:39981	UCRL—82272
	4:40002	UCID—18156
	4:40014	UCRL—52521
	4:40015	UCRL—81896
	4:40016	UCRL—82120
	4:40019	LBL—8900
W-7405-ENG-82	Ames Lab., IA (USA)	
	4:38044	IS—4668
	4:38469	IS-M—192
	4:39801	IS-T—852

REPORT NUMBER INDEX

The numbers assigned to all reports cited in the publication appear in the first column of the index. The citation numbers are included in the second column. Cross reference information and/or availability are included as appropriate. Abbreviations used in the availability column are elaborated at the end of the index.

Report No.	*Abstract No.*	*Availability*
ABCC-TR-		
73-74	4:39660	Dep. NTIS, PC A05/MF A01
ACD-		
38391-12	4:38046	Dep. NTIS, PC A02/MF A01
AD-		
923260	4:39281	NTIS PCA02/MF A01
AD-A-		
057405	4:38566	NTIS PCA05/MF A01
057417	4:39698	NTIS PCA02/MF A01
057448	4:38581	NTIS PCA07/MF A01
057461	4:39537	NTIS PCA16/MF A01
057503	4:39186	NTIS PCA05/MF A01
057797	4:38205	NTIS PCA02/MF A01
057881	4:39939	NTIS PCA03/MF A01
057898	4:39899	NTIS PCA04/MF A01
057904	4:39282	NTIS PCA05/MF A01
057953	4:38908	NTIS PCA03/MF A01
057975	4:39765	NTIS PCA03/MF A01
058054	4:38914	NTIS PCA10/MF A01
058093	4:39499	NTIS PCA05/MF A01
058200	4:38915	
058227	4:39525	
058229	4:39216	NTIS PCA02/MF A01
058245	4:39766	NTIS PCA03/MF A01
058246	4:39761	NTIS PCA02/MF A01
058269	4:39944	NTIS PCA02/MF A01
058301	4:39524	NTIS PCA05/MF A01
058306	4:39283	NTIS PCA03/MF A01
058325	4:39743	NTIS PCA02/MF A01
058360	4:39500	NTIS PCA07/MF A01
058366	4:39496	NTIS PCA03/MF A01
058380	4:38987	NTIS PCA03/MF A01
058404	4:39501	NTIS PCA03/MF A01
058421	4:38609	NTIS PCA14/MF A01
058449	4:39699	NTIS PCA03/MF A01
058456	4:38988	NTIS PCA02/MF A01
058626	4:38415	NTIS PCA10/MF A01
058637	4:38990	NTIS PCA06/MF A01
058684	4:39762	NTIS PCA03/MF A01
058697	4:39217	NTIS PCA02/MF A01
058802	4:38162	NTIS PCA06/MF A01
059295	4:38845	NTIS PCA07/MF A01
059300	4:38848	NTIS PCA03/MF A01
059309	4:38991	NTIS PCA08/MF A01
059327	4:39926	NTIS PCA05/MF A01
059337	4:39379	NTIS PCA03/MF A01
059365	4:39076	NTIS PCA07/MF A01
059381	4:38174	NTIS PCA03/MF A01
059384	4:38943	NTIS PCA03/MF A01
059429	4:39284	NTIS PCA07/MF A01
059446	4:39502	NTIS PCA09/MF A01
059447	4:39218	NTIS PCA03/MF A01
059503	4:39219	NTIS PCA02/MF A01
059512	4:39596	NTIS PCA06/MF A01
059529	4:39526	NTIS PCA07/MF A01
059533	4:39800	NTIS PCA02/MF A01
059534	4:39072	NTIS PCA07/MF A01
059655	4:38172	NTIS PCA03/MF A01
059705	4:39522	NTIS PCA04/MF A01
059736	4:38833	NTIS PCA02/MF A01
059749	4:39700	NTIS PCA02/MF A01
059809	4:39538	NTIS PCA03/MF A01
059811	4:39285	NTIS PCA06/MF A01
059845	4:39788	NTIS PCA02/MF A01
059877	4:39985	NTIS PCA02/MF A01
059882	4:39770	NTIS PCA02/MF A01
AECL-		
5807(rev.1)	4:39275	Dep. NTIS (US Sales Only), PC A03/MF A01
5917	4:39276	Dep. NTIS (US Sales Only), PC A03/MF A01
6184	4:38731	Dep. NTIS (US Sales Only), PC A03/MF A01
6212	4:38751	Dep. NTIS (US Sales Only), PC A03/MF A01
AED-Conf-		
78-023-002	4:38720	Dep. NTIS (US Sales Only), PC A03/MF A01
78-023-004	4:38789	Dep. NTIS (US Sales Only), PC A03/MF A01
78-048-003	4:38732	Dep. NTIS (US Sales Only), PC A02/MF A01
78-150-004	4:39220	Dep. NTIS (US Sales Only), PC A05/MF A01
78-155-006	4:38630	Available from ZAED
78-155-017	4:38567	Dep. NTIS (US Sales Only), PC A03/MF A01
78-155-024	4:38568	Dep. NTIS (US Sales Only), PC A02/MF A01
78-155-027	4:38752	Dep. NTIS (US Sales Only), PC A02/MF A01
78-155-033	4:38753	Dep. NTIS (US Sales Only), PC A02/MF A01
78-270-002	4:38416	Dep. NTIS (US Sales Only), PC A02/MF A01
AERE-R-		
8790	4:38259	Dep. NTIS (US Sales Only), PC A02/MF A01
AGARD-CP-		
243	4:39134	NTIS
AMMRC-TR-		
79-11	4:39073	Dep. NTIS, PC A06/MF A01
ANL-		
77-96	4:38685	*See* NUREG/CR-0785
78-1	4:38684	*See* NUREG/CR-0001
78-65(Pt.2)	4:39670	Dep. NTIS, PC A13/MF A01
78-99	4:38661	AT
78-103	4:38790	Dep. NTIS, PC A04/MF A01
ANL-CT-		
79-16	4:38662	AT
ANL/EES-TM-		
40	4:38909	Dep. NTIS, PC A04/MF A01
ANL/FPP/TM-		
118	4:39268	Dep. NTIS, PC A03/MF A01
ANL/NDM-		
46	4:39909	Dep. NTIS, PC A03/MF A01
ANL/OTEC-		
001	4:38410	Dep. NTIS, PC A03/MF A01

Report No.	Abstract No.	Availability
ANL/OTEC-TM-1	4:38411	Dep. NTIS, PC A03/MF A01
ANL/RER-78-2	4:39539	Dep. NTIS, PC A05/MF A01
ANL/WR-79-3	4:38161	Dep. NTIS, PC A05/MF A01
BDX-613-2165	4:39101	Dep. NTIS, PC A02/MF A01
613-2173	4:39331	Dep. NTIS, PC A03/MF A01
BETC-79/1	4:38137	Dep. NTIS, PC A08/MF A01
0001-1	4:38138	Dep. NTIS, PC A04/MF A01
0007-3	4:38139	Dep. NTIS, PC A06/MF A01
2180-4	4:38140	Dep. NTIS, PC A02/MF A01
5603-5	4:39235	Dep. NTIS, PC A07/MF A01
5603-6	4:39236	Dep. NTIS, PC A03/MF A01
BETC/RI-79/2	4:39089	Dep. NTIS, PC A02/MF A01
BMFT-FB-T-78-08	4:39208	Dep. NTIS (US Sales Only), PC A02/MF A01
BMI-2019	4:38815	*See* NUREG/CR-0651
2022	4:38816	*See* NUREG/CR-0697
2023	4:38817	*See* NUREG/CR-0698
BMVg-FBWT-78-20	4:38839	Dep. NTIS (US Sales Only), PC A05/MF A01
BNL-24848	4:39819	Dep. NTIS, PC A02/MF A01
25002	4:39540	Dep. NTIS, PC A02/MF A01
25026	4:39528	Dep. NTIS, PC A02/MF A01
25114	4:39612	Dep. NTIS, PC A02/MF A01
25311	4:39433	Dep. NTIS, PC A02/MF A01
25587	4:38601	Dep. NTIS, PC A02/MF A01
25634	4:38301	Dep. NTIS, PC A02/MF A01
25730	4:39667	Dep. NTIS, PC A02/MF A01
25733	4:39466	Dep. NTIS, PC A02/MF A01
25734	4:39434	Dep. NTIS, PC A02/MF A01
25755	4:39467	Dep. NTIS, PC A02/MF A01
25774	4:39468	Dep. NTIS, PC A02/MF A01
25783	4:39469	Dep. NTIS, PC A02/MF A01
25784	4:39429	Dep. NTIS, PC A02/MF A01
25788	4:39380	Dep. NTIS, PC A02/MF A01
25793	4:39470	
25795	4:39435	Dep. NTIS, PC A02/MF A01
25796	4:39436	Dep. NTIS, PC A02/MF A01
25797	4:39437	Dep. NTIS, PC A02/MF A01
25798	4:39471	Dep. NTIS, PC A02/MF A01
25799	4:39472	Dep. NTIS, PC A02/MF A01
25822	4:39473	Dep. NTIS, PC A02/MF A01
25857	4:39474	Dep. NTIS, PC A02/MF A01
25877	4:39908	Dep. NTIS, PC A02/MF A01
25879	4:39822	Dep. NTIS, PC A02/MF A01
25880	4:39438	Dep. NTIS, PC A03/MF A01
25910	4:39692	Dep. NTIS, PC A02/MF A01
25933	4:38860	Dep. NTIS, PC A02/MF A01
50961	4:39269	Dep. NTIS, PC A03/MF A01
BNL-NUREG-25635	4:40005	Dep. NTIS, PC A02/MF A01
25714	4:38791	Dep. NTIS, PC A02/MF A01
50931	4:38812	*See* NUREG/CR-0513
BNL-tr-678	4:39919	Dep. NTIS, PC A02/MF A01
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BR-9795	4:38500	*See* SAND-78-7034
CEA-CONF-3997	4:38733	Dep. NTIS (US Sales Only), PC A03/MF A01
3999	4:38792	Dep. NTIS (US Sales Only), PC A03/MF A01
4035	4:38793	Dep. NTIS (US Sales Only), PC A02/MF A01
CH-225/78	4:38258	*See* SGAE-2875
CONF-720571-2(Trans)	(International congress on hydrogen in metals conference, Paris, France, 29 May 1972) 4:39147	*See* MLM-2600(TR)
CONF-7505149-	(Piston ring scuffing conference, London, UK, 13-14 May 1975) 4:39078	Mechanical Engineering Publications Ltd., P.O. Box 24, Northgate Ave., Bury St. Edmunds, Suffolk, England
CONF-7509184-	(26. International Astronautical Congress, Lisbon, Portugal, 21-27 Sep 1975) 4:38354	Elmsford, NY; Pergamon Press Inc. (1977).
CONF-760113-	(3. annual symposium on computer architecture, Clearwater, FL, USA, 19-21 Jan 1976) 4:40048	IEEE Computer Society Publications Office, 5855 Naples Plaza, Suite 301, Long Beach, CA
CONF-7608130-	(International advanced course on heat disposal from power generation, Dubrovnik, Yugoslavia, 23-28 Aug 1976) 4:39622	The Publisher, 1025 Vermont Ave., NW, Washington, DC
CONF-7611113-	(12. annual pipeline operation and maintenance institute, Liberal, KS, USA, 16-17 Nov 1976) 4:38183	TIC
CONF-7704100-	(Conference on vehicle structural mechanics, Southfield, MI, USA, 18-20 Apr 1977) 4:39077	$30.00
CONF-7704104-	(International air transportation conference, Washington, DC, USA, 4-6 Apr 1977) 4:39019	$16.00
CONF-7705166-2	(French-Soviet colloquium on the operation of power plants equipped with water reactors, Moscow, USSR, 31 May-10 Jun 1977) 4:38733	*See* CEA-CONF-3997
CONF-7706164-1	(1. international meeting on new sources of energy, Paris, France, 13-17 Jun 1977) 4:38718	*See* TECHNICATOME-CONF-77-1
CONF-7706173-	(Technical committee meeting on heat utilization from nuclear reactors for desalting of sea water, Vienna, Austria, 29 Jun-1 Jul 1977) 4:38712	*See* IAEA-206
CONF-770844-6	(International optical computing conference, San Diego, CA, USA, 25-26 Aug 1977) 4:39510	*See* Y/DA-7109
CONF-7708110-	(VGB international congress on power stations, Copenhagen, Denmark, 30 Aug-1 Sep 1977) 4:38565	Dep. NTIS (US Sales Only), PC A99/MF A01
CONF-770906-P2	(8. European conference on controlled fusion and plasma physics, Prague, Czechoslovakia, 19-23 Sep 1977) 4:40003	*See* INIS-mf-4125
CONF-770948-	(SNEAP conference, Los Alamos, NM, USA, 26-28 Sep 1977) 4:39359	*See* LA-7445-C
CONF-770954-(Summ.)	(2. conference on hot plasma diagnostics, Kharkov, USSR, 22-27 Sep 1977) 4:39972	*See* INIS-mf-4403
CONF-7709174-(Summ.)	(8. European conference on controlled fusion and plasma physics, Zdikov, Czechoslovakia, 26-28 Sep 1977) 4:40004	*See* INIS-mf-4324
CONF-7709177-1	(11. international school for young scientistis on high energy phisics and relativistic nuclear physics, Gomel, Byelorussian SSR, 12-23 Sep 1977) 4:39853	*See* FERMILAB-CONF-78/37-THY
CONF-7709179-1	(International study workshop on solar heating in residences, Liege, Belgium, 12-14 Sep 1977) 4:38461	Dep. NTIS (US Sales Only), PC A03/MF A01
CONF-771035-P2	(2. international topical conference, Ithaca, NY, USA, 3-5 Oct 1977) 4:39439	Dep. NTIS, PC A18/MF A01
CONF-7710149-1	(6. ASTE scientific and technical meeting, Paris, France, 26-28 Oct 1977) 4:38793	*See* CEA-CONF-4035
CONF-7710193-	(40. IBMA convention, Chicago, IL, USA, 12-14 Oct 1977)	

Report No.	Abstract No.	Availability
	4:38843	Largo, FL; Independent Battery Manufacturers Association, Inc. (1977).
CONF-771109-		(ANS winter meeting, San Francisco, CA, USA, 27 Nov-2 Dec 1977)
112	4:38668	*See* HEDL-SA-1329
CONF-7711108-		(Desiccant cooling conference, Golden, CO, USA, 16 Nov 1977)
(Summ.)	4:38481	*See* SERI-22
CONF-771209-		(IAEA symposium on national and international standardization of radiation dosimetry, Atlanta, GA, USA, 5-9 Dec 1977)
P2	4:39665	*See* STI/PUB-471(Vol.2)
CONF-771255-		(Conference on recent developments in high temperature design methods, London, UK, 6 Dec 1977)
	4:39144	London, England; Mechanical Engineering Publications for IMechE (1977).
CONF-771272-		(5. international conference on fluidized bed combustion, Washington, DC, USA, 12-14 Dec 1977)
P1	4:38125	*See* M-78-68(Vol.1)
CONF-780161-		(International conference on bioenergy, Zurich, Switzerland, 12-13 Jan 1978)
1	4:38308	Univ. of Miami, FL
CONF-780246-		(International symposium on quality assurance, Bad Neuenahr, F.R. Germany, 27-28 Feb 1978)
1	4:38732	*See* AED-Conf-78-048-003
CONF-780261-		(Meeting of the Society for Range Management, San Antonio, TX, USA, 5-10 Feb 1978)
1	4:39606	*See* BNWL-SA-6532
CONF-780272-		(Meeting on reactor engineering and nuclear power supply, Essen, F.R. Germany, 27-28 Feb 1978)
1	4:38720	*See* AED-Conf-78-023-002
3	4:38789	*See* AED-Conf-78-023-004
CONF-780337-		(2. national passive solar conference, Philadelphia, PA, USA, 16-18 Mar 1978)
P1	4:38417	Dep. NTIS, PC A05/MF A01
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P3	4:38451	Dep. NTIS, PC A06/MF A01
CONF-780345-		(p-p workshop, Berkeley, CA, USA, 27-31 Mar 1978)
	4:39475	*See* LBL-7574
CONF-780463-		(3. international school on neutron physics, Alushta, USSR, 19-30 Apr 1978)
	4:39880	Dubna, USSR; Joint Inst. for Nuclear Research (1978).
CONF-780487-		(11. meeting on fast reactors, Bologna, Italy, 17-20 Apr 1978)
P3(Summ.)	4:38678	*See* IWGFR-24-3
CONF-7804102-		(Systems exhibition energy within the context of the Hannover fair, Hannover, F.R. Germany, 19-27 Apr 1978)
28	4:38567	*See* AED-Conf-78-155-017
29	4:38753	*See* AED-Conf-78-155-033
30	4:38752	*See* AED-Conf-78-155-027
31	4:38568	*See* AED-Conf-78-155-024
32	4:38630	*See* AED-Conf-78-155-006
CONF-7804115-		(46. meeting of the AGARD structures and materials panel, Aalborg, Denmark, 11-12 Apr 1978)
	4:39134	NTIS
CONF-7804122-		(Symposium on the foundation of radiation theory and quantum electrodynamics, Boulder, CO, USA, 28-29 Apr 1978)
1	4:39802	*See* LA-UR-79-218
CONF-780571-		(153. meeting of the Electrochemical Society, Seattle, WA, USA, 21-26 May 1978)
P1	4:39343	Princeton, NJ; Electrochemical Society, Inc. (1978).
CONF-780589-		(Conference on vibration in nuclear plant, Keswick, UK, 9-11 May 1978)
2	4:38731	*See* AECL-6184
CONF-7805133-		(77. meeting of the deutsche bunsengesellschaft fuer physikalische gesellschaft, Konstanz, F.R. Germany, 4-6 May 1978)
	4:39220	*See* AED-Conf-78-150-004
CONF-7805142-		(US-USSR cooperative program in MHD power generation, Gaithersburg, MD, USA, 24-25 May 1978)
1	4:38967	Dep. NTIS, PC A03/MF A01
CONF-780622-		(ANS annual meeting, San Diego, CA, USA, 18-23 Jun 1978)
30	4:39360	Dep. NTIS, MF A01
CONF-780636-		(71. Air Pollution Control Association meeting, Houston, TX, USA, 25-30 Jun 1978)
13	4:39541	*See* COO-1199-54
CONF-7806122-		(BR2 reactor review meeting, Mol, Belgium, 1 Jun 1978)
	4:38781	*See* INIS-mf-4426
CONF-7806125-		(1978 annual conference of the Canadian Nuclear Association, Ottawa, Canada, 11-14 Jun 1978)
2	4:38751	*See* AECL-6212
CONF-7806134-		(6. Treiste conference on particle physics, Trieste, Italy, 26-30 Jun 1978)
1	4:39815	*See* SLAC-PUB-2218
CONF-780762-		(Conference on neutrino physics at accelerators, Oxford, UK, 3-7 Jul 1978)
8	4:39819	*See* BNL-24848
CONF-780788-		(9. international symposium on high energy multiparticle dynamics, Tabor, Czechoslovakia, 2-7 Jul 1978)
3	4:39852	*See* DOE/ER/70004-207
CONF-780826-		(19. conference on high energy physics, Tokyo, Japan, 23-31 Aug 1978)
28	4:39824	*See* COO-2232A-68
29	4:39823	*See* COO-2232A-67
30	4:39820	*See* COO-3071-237
CONF-780880-		(Workshop on flow-induced vibrations, Palo Alto, CA, USA, 21-22 Aug 1978)
	4:38736	*See* EPRI-WS-78-125
CONF-780889-		(Symposium on energy from biomass and wastes, Washington, DC, USA, 14-18 Aug 1978)
	4:38400	Chicago, IL; Institute of Gas Technology (1978).
CONF-780892-		(Bubble chamber symposium, Sandai, Japan, 17-18 Aug 1978)
1	4:39433	*See* BNL-25311
CONF-7808101-		(18. AIChe-ASME national heat transfer conference, San Diego, CA, USA, 5-8 Aug 1978)
1	4:39258	*See* LA-UR-79-332
CONF-780919-		(14. conference on the physics of semiconductors, Edinburgh, UK, 4-8 Sep 1978)
	4:39950	American Inst. of Physics, 335 East 45 Street, New York, NY
CONF-780952-		(Applied superconductivity conference, Pittsburgh, PA, USA, 25-28 Sep 1978)
24	4:38958	Dep. NTIS, MF A01
CONF-7809122-		(2. building physics congress on the occasion of the ISO/glass technical fair, Duesseldorf, F.R. Germany, 28 Sep-1 Oct 1978)
3	4:38416	*See* AED-Conf-78-270-002
CONF-7809138-		(6. annual Illinois energy conference on electric utilities, Chicago, IL, USA, 27-29 Sep 1978)
1	4:39003	Dep. NTIS, PC A02/MF A01
CONF-781003-		(53. annual technical conference and exhibition of society of pertoleum engineers, Houston, TX, USA, 1-4 Oct 1978)
6	4:38546	*See* LBL-7091
CONF-781009-		(4. US-USSR colloquium on MHD electric power generation, Washington, DC, USA, 5-6 Oct 1978)
	4:38944	Dep. NTIS, PC A99/MF A01
CONF-781095-		(Symposium on high energy physics, Argonne, IL, USA, 26-28 Oct 1978)
6	4:39481	*See* SLAC-PUB-2258
CONF-7810132-		(Pacific Northwest Bioconversion workshop, Portland, OR, USA, 24-26 Oct 1978)
	4:38399	*See* RLO-78-5
CONF-7810144-		(Meeting of Japan section of the American Nuclear Society, Tokyo, Japan, 25 Oct 1978)
1	4:38778	*See* HEDL-SA-1671
CONF-7810164-		(4. European electro-optics conference, Utrecht, Netherlands, 10-13 Oct 1978)
1	4:39542	*See* GKSS-78/E/42
CONF-781105-		(ANS meeting, Washington, DC, USA, 12-17 Nov 1978)

Report No.	Abstract No.	Availability
100	4:39601	Dep. NTIS, PC A02/MF A01
102	4:39254	*See* LBL-8548
CONF-781109-	(Environmental control symposium, Washington, DC, USA, 28-30 Nov 1978)	
27	4:39279	*See* SAND-78-1584C
CONF-781121-	(Annual meeting of Materials Research Society, Boston, MA, USA, 28 Nov-1 Dec 1978)	
22	4:39196	Dep. NTIS, PC A02/MF A01
CONF-781174-	(Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications, Upton, NY, USA, 20-22 Nov 1978)	
1	4:39922	*See* LA-UR-78-3062
2	4:39923	*See* UCRL-81909
CONF-781175-	(46. International Astronomical Union colloquium on Changing trends in variable star research, Hamilton, New Zealand, 27 Nov-1 Dec 1978)	
1	4:39731	*See* LA-UR-78-3089
CONF-7811123-	(35. DAMSUL committee meeting, Aiken, SC, USA, 17 Nov 1978)	
1	4:39509	*See* UCRL-82358
CONF-781201-	(National conference for developing local public-private enterprises, Philadelphia, PA, USA, 3-5 Dec 1978)	
1	4:38369	State of California SolarCal Office, 921 Tenth St., Sacramento, CA 95814
CONF-781210-	(IEEE electron devices meeting, Washington, DC, USA, 4-6 Dec 1978)	
4	4:39338	*See* SAND-78-1523C
CONF-781213-	(Winter simulation conference, Miami Beach, FL, USA, 4-6 Dec 1978)	
2	4:40039	*See* LA-UR-78-2116
6	4:38897	Dep. NTIS, MF A01
CONF-781222-	(4. workshop on geothermal reservoir engineering, Stanford, CA, USA, 13-15 Dec 1978)	
2	4:38526	*See* LBL-8675
CONF-781228-	(Reliability of materials workshop, Denver, CO, USA, 18-20 Dec 1978)	
1	4:38507	*See* SAND-79-0246C
CONF-781235-	(Symposium on commercialization of solar and conservation technologies, Miami Beach, FL, USA, 11-13 Dec 1978)	
3	4:38563	*See* SERI/TP-51-158
4	4:38367	*See* SERI/TP-53-123
CONF-781243-	(Seminar on proton stability, Madison, WI, USA, 8 Dec 1978)	
1	4:39863	*See* LA-UR-79-361
2	4:39835	*See* UH-511-330-79
CONF-781244-	(Workshop on design of industrial energy information systems, Hilton Head Island, SC, USA, 6-8 Dec 1978)	
1	4:39028	Dep. NTIS, PC A03/MF A01
CONF-781245-	(13. Texas conference on relativistic astrophysics, Munich, F.R. Germany, 14-20 Dec 1978)	
2	4:39736	*See* UCRL-82057(Rev.1)
CONF-790101-	(4. symposium on turbulence, diffusion and air pollution, Reno, NV, USA, 15-18 Jan 1979)	
6	4:39529	Dep. NTIS, PC A02/MF A01
8	4:39528	*See* BNL-25026
12	4:39540	*See* BNL-25002
CONF-790118-	(3. national passive solar conference, San Jose, CA, USA, 11-13 Jan 1979)	
5	4:38469	*See* IS-M-192
6	4:38471	*See* LBL-8814
CONF-790119-	(5. symposium on reservoir simulation, Denver, CO, USA, 31 Jan-2 Feb 1979)	
2	4:38512	*See* LBL-8802
CONF-790125-	(1. topical meeting on fusion reactor materials, Miami Beach, FL, USA, 29-31 Jan 1979)	
41	4:40013	*See* HEDL-SA-1594-FP
43	4:40006	*See* PPPL-1537
46	4:40007	*See* UWFDM-288
CONF-790140-	(International workshop on gross properties of nuclei and nuclear excitations VII, Hirschegg, Kleinwalsertal, Austria, 15-20 Jan 1979)	
1	4:39932	*See* COO-3496-70
4	4:39914	*See* LBL-8613
CONF-790143-	(Conference on future possibilities for electron accelerators, Charlottesville, VA, USA, 8-10 Jan 1979)	
1	4:39446	*See* LA-UR-79-463
2	4:39482	*See* SLAC-PUB-2262
CONF-790144-	(Workshop on particle accleration mechanisms in astrophysics, La Jolla, CA, USA, 3-5 Jan 1979)	
1	4:39738	*See* LA-UR-79-309
CONF-790146-	(4. annual SAS User's group conference, Clearwater Beach, FL, USA, 28-31 Jan 1979)	
1	4:40050	Dep. NTIS, PC A02/MF A01
CONF-790207-	(10. symposium on explosives and pyrotechnics, San Francisco, CA, USA, 14-16 Feb 1979)	
5	4:39518	*See* SAND-78-1731C
CONF-790305-	(ASME gas turbine closed-cycle session, San Diego, CA, USA, 11-15 Mar 1979)	
3	4:38601	*See* BNL-25587
CONF-790306-	(International conference on fast breeder reactor performance, Monterey, CA, USA, 5-8 Mar 1979)	
9	4:38670	*See* HEDL-SA-1536-FP
10	4:38671	*See* HEDL-SA-1543-FP
11	4:38672	*See* HEDL-SA-1683-FP
12	4:38669	*See* HEDL-SA-1535-FP
CONF-790307-	(International conference on fracture mechanics in engineering applications, Bangalore, India, 26-30 Mar 1979)	
70	4:39474	*See* BNL-25857
92	4:39459	*See* LBL-8947
CONF-790311-	(2. international conference on comp. meth. in nonlinear mech., Austin, TX, USA, 26-28 Mar 1979)	
2	4:40042	*See* SAND-79-0458C
CONF-790313-	(NACE/Corrosion 1979 meeting, Atlanta, GA, USA, 12-16 Mar 1979)	
4	4:38631	Dep. NTIS, PC A02/MF A01
CONF-790320-	(Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks, Paris, France, 19-21 Mar 1979)	
2	4:39707	*See* DP-MS-79-11
CONF-790323-	(Symposium on high spin phenomena in nuclei, Argonne, IL, USA, 15-17 Mar 1979)	
3	4:39908	*See* BNL-25877
CONF-790325-	(International symposium on biological implications of radionuclides released from nuclear industries, Vienna, Austria, 26-30 Mar 1979)	
6	4:39692	*See* BNL-25910
7	4:39667	*See* BNL-25730
CONF-790327-	(IEEE particle accelerator conference, San Francisco, CA, USA, 12-14 Mar 1979)	
1	4:39429	*See* BNL-25784
2	4:39467	*See* BNL-25755
3	4:39441	Dep. NTIS, PC A02/MF A01
4	4:39473	*See* BNL-25822
5	4:39468	*See* BNL-25774
6	4:39469	*See* BNL-25783
8	4:39442	Dep. NTIS, PC A02/MF A01
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10	4:39426	Dep. NTIS, PC A02/MF A01
13	4:39401	*See* LA-UR-79-695
14	4:39450	*See* LA-UR-79-688
18	4:39449	*See* LA-UR-79-685
19	4:39400	*See* LA-UR-79-676
21	4:39452	*See* LA-UR-79-705
22	4:39451	*See* LA-UR-79-689
23	4:39289	*See* LA-UR-79-675
24	4:39448	*See* LA-UR-79-658
25	4:39408	*See* LA-UR-657
26	4:39447	*See* LA-UR-79-651
29	4:39404	*See* LA-UR-79-709
30	4:39405	*See* LA-UR-79-710
34	4:39453	*See* LA-UR-79-714
37	4:39402	*See* LA-UR-79-699
40	4:39432	*See* LA-UR-79-703
41	4:39403	*See* LA-UR-79-701
47	4:39406	*See* LA-UR-79-750
48	4:39407	*See* LA-UR-79-751
56	4:39471	*See* BNL-25798
58	4:39437	*See* BNL-25797
61	4:39470	*See* BNL-25793
62	4:39466	*See* BNL-25733
65	4:39380	*See* BNL-25788

Report No.	Abstract No.	Availability
67	4:39472	*See* BNL-25799
68	4:39435	*See* BNL-25795
69	4:39436	*See* BNL-25796
71	4:39457	*See* LBL-8808
72	4:39423	*See* UCRL-81834
73	4:39461	*See* SAND-79-0596C
77	4:39480	*See* SLAC-PUB-2255
79	4:39484	*See* SLAC-PUB-2267
80	4:39485	*See* SLAC-PUB-2270
81	4:39462	*See* SLAC-PUB-2266
85	4:39483	*See* SLAC-PUB-2265
87	4:39479	*See* LBL-8887
91	4:39795	*See* LBL-8932
95	4:39458	*See* LBL-8818
98	4:40019	*See* LBL-8900
160	4:39434	*See* BNL-25734
CONF-790328-	(Solar energy storage options workshop, San Antonio, TX, USA, 18-20 Mar 1979)	
1	4:38506	*See* MLM-2598(OP)
2	4:38492	*See* MLM-2606(OP)
CONF-790329-	(3. workshop on rotating gases, Rome, Italy, 27-29 Mar 1979)	
1	4:39327	*See* UCRL-82436
CONF-790330-	(UCC gas chromatography specialists group meeting, Pittsburgh, PA, USA, 6 Mar 1979)	
1	4:39214	Dep. NTIS, PC A02/MF A01
CONF-790331-	(Waste management seminar, Oak Ridge, TN, USA, 6-7 Mar 1979)	
1	4:38875	Dep. NTIS, PC A02/MF A01
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3	4:38261	Dep. NTIS, PC A02/MF A01
4	4:38249	Dep. NTIS, PC A02/MF A01
CONF-790337-	(New fuels and advances in combustion technologies symposium, New Orleans, LA, USA, 26-30 Mar 1979)	
3	4:38175	NP
CONF-790340-	(Meeting of the Japanese nuclear society, Osaka, Japan, 26-28 Mar 1979)	
1	4:38794	Dep. NTIS, PC A04/MF A01
CONF-790341-	(International conference on modulated structures, Kailua-Kona, HI, USA, 22-25 Mar 1979)	
1(Draft)	4:39102	Dep. NTIS, PC A02/MF A01
2	4:39173	Dep. NTIS, PC A02/MF A01
3	4:39174	Dep. NTIS, PC A02/MF A01
4	4:39175	Dep. NTIS, PC A02/MF A01
CONF-790342-	(US-Japan seminar on long-range in ordering in Crystals, Honolulu, HI, USA, 18-21 Mar 1979)	
1	4:39945	Dep. NTIS, PC A02/MF A01
CONF-790343-	(American Society for Metals advisory technical awareness council meeting, Cleveland, OH, USA, 27 Mar 1979)	
1	4:39106	Dep. NTIS, PC A02/MF A01
CONF-790344-	(Conference on fundamentals and applications of negative ions in mass spectra, Chapel Hill, NC, USA, 22-23 Mar 1979)	
1	4:39783	Dep. NTIS, PC A05/MF A01
CONF-790347-	(2. international conference on meson-nuclear physics, Houston, TX, USA, 5-9 Mar 1979)	
1	4:39831	*See* LA-UR-79-653
2	4:39454	*See* LA-UR-79-898
3	4:39903	*See* LA-UR-79-839
4	4:39832	*See* LA-UR-79-893
5	4:39885	*See* LA-UR-79-638
6	4:39934	*See* LBL-8758
7	4:39822	*See* BNL-25879
CONF-790351-	(EPA seminar and workshop on persistent elevated pollution episodes, Durham, NC, USA, 19-23 Mar 1979)	
1	4:39573	*See* UCRL-82549
CONF-790405-	(AICE meeting, Houston, TX, USA, 1-5 Apr 1979)	
12	4:38047	Dep. NTIS, PC A03/MF A01
14	4:38048	Dep. NTIS, PC A02/MF A01
15	4:39049	*See* Y/DA-8220
CONF-790409-	(ASNT spring conference, San Diego, CA, USA, 2-5 Apr 1979)	
2	4:39103	*See* UCRL-81879
CONF-790411-	(Faraday general discussion No. 67 "Kinetics of State-Selected Species", Birmingham, UK, 9-11 Apr 1979)	
1	4:39794	*See* LBL-7686
CONF-790415-	(177. ACS national meeting, Honolulu, HI, USA, 1-6 Apr 1979)	
2	4:39545	*See* LBL-7999
4	4:39612	*See* BNL-25114
21	4:39253	Dep. NTIS, PC A02/MF A01
24	4:39181	Dep. NTIS, PC A02/MF A01
25	4:38071	Dep. NTIS, PC A02/MF A01
26	4:38081	Dep. NTIS, PC A02/MF A01
29	4:38242	*See* RFP-2887
30	4:38241	*See* RFP-2886
31	4:38130	Dep. NTIS, PC A02/MF A01
CONF-790418-	(Scanning electron microscopy conference, Washington, DC, USA, 16-20 Apr 1979)	
4	4:38082	Dep. NTIS, PC A02/MF A01
CONF-790420-	(International symposium on ceramics in nuclear waste management, Cincinnati, OH, USA, 30 Apr-2 May 1979)	
9	4:38250	Dep. NTIS, PC A02/MF A01
CONF-790423-	(2. multiphase flow and heat transfer symposium workshop, Miami Beach, FL, USA, 16-18 Apr 1979)	
3	4:38795	Dep. NTIS, PC A03/MF A01
6	4:39438	*See* BNL-25880
CONF-790426-	(International conference on welding and fabrication in the nuclear industry, London, UK, 2-6 Apr 1979)	
2	4:38667	*See* GEFR-SP-151
CONF-790428-	(Symposium on the foundations of radiation theory and quantum electrodynamics, Boulder, CO, USA, 28-29 Apr 1979)	
1	4:39841	*See* LA-UR-79-357
CONF-790429-	(4. specialist meeting on fuel-coolant interaction in nuclear reactor safety, Bournemouth, UK, 2-5 Apr 1979)	
1	4:38823	*See* SAND-78-0261C
CONF-790430-	(1. annual symposium on safeguards and nuclear material management, Brussels, Belgium, 25-27 Apr 1979)	
1	4:38290	*See* K/OA-4488
2	4:38289	Dep. NTIS, PC A02/MF A01
CONF-790431-	(20. AESOP conference, Gatlinburg, TN, USA, 24 Apr 1979)	
1	4:40041	*See* RFP-2902
CONF-790433-	(Symposium on geothermal energy and its direct uses in the eastern United States, Hot Springs, VA, USA, 5-7 Apr 1979)	
2	4:38519	*See* LA-UR-79-665
CONF-790434-	(Spring meeting on western states section, and the Combustion Institute, Provo, UT, USA, 23-24 Apr 1979)	
2	4:39255	*See* UCRL-82181
CONF-790435-	(CAM-I international spring seminar, New Orleans, LA, USA, 9-13 Apr 1979)	
1	4:39097	*See* Y/DA-8239
CONF-790436-	(SIRA-NPL conference on advances in optical production technology, Teddington, Middlesex, UK, 24-25 Apr 1979)	
1	4:39096	*See* UCRL-82528
CONF-790437-	(5. international conference on positron annihilation, Lake Yamanaka, Japan, 8-11 Apr 1979)	
1	4:39128	*See* SAND-79-0636C
2	4:39169	*See* UCRL-82159
3	4:39094	*See* SAND-79-0727C
CONF-790438-	(DOE/BES research meeting on high energy atomic physics, Manhattan, KS, USA, 5-7 Apr 1979)	
1	4:39789	Dep. NTIS, PC A02/MF A01
CONF-790440-	(12. oil shale symposium, Golden, CO, USA, 18-20 Apr 1979)	
2	4:38192	*See* SAND-79-0746C
CONF-790442-	(International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Apr 1979)	
3	4:39177	*See* SAND-79-2076C
6	4:39331	*See* BDX-613-2173
8	4:39095	*See* SAND-79-0922C
CONF-790443-	(American power conference, Chicago, IL, USA, 23-25 Apr 1979)	
2	4:39039	Dep. NTIS, PC A02/MF A01
CONF-790446-	(4. annual heat pump technology conference, Stillwater, OK, USA, 9-10 Apr 1979)	
4	4:38992	Dep. NTIS, PC A02/MF A01
CONF-790450-	(International symposium on pulse plating, Boston, MA, USA, 19-20 Apr 1979)	
1	4:39101	*See* BDX-613-2165

Report No.	Abstract No.	Availability
CONF-790502-		(Caranahan conference on crime countermeasures, Lexington, KY, USA, 6-18 May 1979)
4	4:38299	*See* Y/DA-7999
CONF-790505-		(25. ISA international instrumentation symposium, Anaheim, CA, USA, 7-9 May 1979)
1	4:39179	*See* SAND-79-0413C
CONF-790506-		(29. electronic components conference, Cherry Hill, NJ, USA, 14-16 May 1979)
1	4:38614	*See* SAND-79-0396C
2	4:39093	*See* SAND-79-0352C
3	4:39340	*See* SAND-79-0388C
CONF-790507-		(IAEA symposium on physics and chemistry of fission, Julich, F.R. Germany, 14-18 May 1979)
1	4:39938	*See* LA-UR-79-533
CONF-790514-		(Symposium on low-permeability gas reservoirs, Denver, CO, USA, 20-22 May 1979)
1	4:38182	*See* UCRL-81707
CONF-790519-		(European nuclear conference, Hamburg, F.R. Germany, 6-11 May 1979)
1	4:38824	*See* SAND-78-2074C
CONF-790523-		(2. international CIB symposium on energy conservation in the built environment, Copenhagen, Denmark, 27 May-1 Jun 1979)
1	4:39010	*See* LBL-8893
2	4:38995	*See* LBL-8892
CONF-790602-		(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)
1	4:39444	*See* COO-4933-1
2	4:38796	Dep. NTIS, PC A02/MF A01
3	4:38797	Dep. NTIS, PC A02/MF A01
9	4:38791	*See* BNL-NUREG-25714
14	4:40005	*See* BNL-NUREG-25635
25	4:38262	Dep. NTIS, PC A02/MF A01
30	4:38248	Dep. NTIS, PC A02/MF A01
39	4:38301	*See* BNL-25634
41	4:39910	Dep. NTIS, PC A02/MF A01
CONF-790603-		(Atlantic software client conference, Philadelphia, PA, USA, 5 Jun 1979)
1	4:40041	*See* RFP-2902
CONF-790605-		(20. annual logging symposium, Tulsa, OK, USA, 3-6 Jun 1979)
1	4:38525	*See* LA-UR-79-723
2	4:38527	*See* SAND-79-0013C
CONF-790606-		(20. US symposium on rock mechanics, Austin, TX, USA, 3-6 Jun 1979)
1	4:38188	*See* LA-UR-79-646
7	4:38189	*See* SAND-78-2268C
CONF-790607-		(NASA stratospheric workshop, Harper's Ferry, WV, USA, 4-8 Jun 1979)
1	4:39533	*See* UCRL-82542
CONF-790608-		(3. Canadian conference on earthquake engineering, Montreal, Canada, 4-6 Jun 1979)
1	4:39958	Dep. NTIS, PC A03/MF A01
CONF-790615-		(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)
9	4:38547	*See* LA-UR-79-670
12	4:38548	*See* LA-UR-79-683
CONF-790623-		(1979 international symposium on fault-tolerant computing, Madison, WI, USA, 20-22 Jun 1979)
1	4:39339	*See* SAND-78-1859C
CONS-		
8630-T1	4:39012	Dep. NTIS, PC A04/MF A01
COO-		
1199-54	4:39541	Dep. NTIS, PC A03/MF A01
1545-250	4:39851	Dep. NTIS, PC A02/MF A01
2003-T1	4:39608	Dep. NTIS, PC A02/MF A01
2012-38	4:39668	Dep. NTIS, PC A02/MF A01
2197-63	4:39829	Dep. NTIS, PC A02/MF A01
2232A-67	4:39823	Dep. NTIS, PC A03/MF A01
2232A-68	4:39824	Dep. NTIS, PC A02/MF A01
2232A-78	4:39814	Dep. NTIS, PC A02/MF A01
2245-65	4:38663	Dep. NTIS, PC A03/MF A01
2245-66	4:38664	Dep. NTIS, PC A02/MF A01
2250-35	4:38665	Dep. NTIS, PC A03/MF A01
2280-37	4:40030	Dep. NTIS, PC A06/MF A01
2360-6	4:39530	Dep. NTIS, PC A04/MF A01
2383-0056	4:40031	Dep. NTIS, PC A03/MF A01
2456-76	4:39971	Dep. NTIS, PC A02/MF A01
2534-4	4:38520	Dep. NTIS, PC A03/MF A01
2640-10	4:39790	Dep. NTIS, PC A02/MF A01
2718-7	4:39791	Dep. NTIS, PC A02/MF A01
2874-46	4:39696	Dep. NTIS, PC A02/MF A01
2960-3	4:39091	Dep. NTIS PC A03/MF A01
3071-237	4:39820	Dep. NTIS, PC A02/MF A01
3077-156	4:40032	Dep. NTIS, PC A03/MF A01
3235-85	4:39931	Dep. NTIS, PC A03/MF A01
3496-70	4:39932	Dep. NTIS, PC A02/MF A01
4018-3	4:38200	Dep. NTIS, PC A16/MF A01
4051-25	4:38531	Dep. NTIS, PC A05/MF A01
4051-27	4:38532	Dep. NTIS, PC A07/MF A01
4051-34	4:38538	Dep. NTIS, PC A04/MF A01
4051-35	4:38541	Dep. NTIS, PC A10/MF A01
4051-38	4:38539	Dep. NTIS, PC A03/MF A01
4051-40	4:38533	Dep. NTIS, PC A02/MF A01
4051-41	4:38534	Dep. NTIS, PC A02/MF A01
4066-9	4:38624	Dep. NTIS, PC A04/MF A01
4206-5	4:38610	Dep. NTIS, PC A03/MF A01
4227-6	4:38083	Dep. NTIS, PC A02/MF A01
4257-3	4:39978	Dep. NTIS, PC A03/MF A01
4274-1	4:38485	Dep. NTIS, PC A06/MF A01
4300-7	4:38412	Dep. NTIS, PC A05/MF A01
4324-T1	4:38072	Dep. NTIS, PC A02/MF A01
4338-4	4:39020	Dep. NTIS, PC A06/MF A01
4517-1	4:38486	Dep. NTIS, PC A02/MF A01
4523-1	4:38504	Dep. NTIS, PC A04/MF A01
4546-5	4:38370	Dep. NTIS, PC A03/MF A01
4577-5	4:38397	Dep. NTIS, PC A03/MF A01
4702-3	4:38505	Dep. NTIS, PC A02/MF A01
4748-1	4:38043	Dep. NTIS, PC A09/MF A01
4933-1	4:39444	Dep. NTIS, PC A02/MF A01
5014-3	4:38619	Dep. NTIS, PC A02/MF A01
DIB-		
78-12-501	4:39487	Domestic and International Business Administration, Washington, DC
DOE/EA-		
0063	4:39635	Dep. NTIS, PC A09/MF A01
DOE/EIA-		
0102/39	4:38916	Dep. NTIS, PC A03/MF A01
0102/51	4:38360	Dep. NTIS, PC A06/MF A01
0103/25	4:40033	Dep. NTIS, PC A04/MF A01
0135	4:38910	Dep. NTIS, PC A06/MF A01
0180	4:38590	Dep. NTIS, PC A07/MF A01
DOE/EIS-		
0026-D(Vol.1)	4:38283	NEPA Coordination Office, Washington, DC
0026-D(Vol.2)	4:38284	NEPA Coordination Office, Washington, DC
0046-D(Vol.1)	4:38285	NEPA Coordination Office, Washington, DC
0046-D(Vol.2)	4:38286	NEPA Coordination Office, Washington, DC
DOE/ER-		
0020	4:39877	Dep. NTIS, PC A08/MF A01
DOE/ER/70004-		
207	4:39852	Dep. NTIS, PC A02/MF A01
218	4:39858	Dep. NTIS, PC A02/MF A01
DOE/ET-		
0064/1	4:38757	Dep. NTIS, PC A05/MF A01
0064/2	4:38758	Dep. NTIS, PC A13/MF A01
0091	4:38830	Dep. NTIS, PC A09/MF A01
00026-8	4:38141	Dep. NTIS, PC A05/MF A01
DOE/EV-		
2307-15	4:39607	Dep. NTIS, PC A04/MF A01
75027-58	4:39611	Dep. NTIS, PC A02/MF A01
DOE/JPL/954527-		
7	4:38371	Dep. NTIS, PC A04/MF A01
DOE/JPL/954853-		
3	4:38372	Dep. NTIS, PC A05/MF A01
4	4:38373	Dep. NTIS, PC A03/MF A01
DOE/JPL/954862-		
4	4:38398	Dep. NTIS, PC A02/MF A01
DOE/JPL/954865-		
3	4:38374	Dep. NTIS, PC A05/MF A01
DOE/JPL/954887-		
4	4:38375	Dep. NTIS, PC A04/MF A01
DOE/JPL/954888-		
3	4:38376	Dep. NTIS, PC A03/MF A01
DOE/NASA/0038-		
79/1	4:38836	Dep. NTIS, PC A06/MF A01
DOE/NASA/CR-		
161151	4:38462	Dep. NTIS, PC A03/MF A01
161166	4:38488	Dep. NTIS, PC A02/MF A01
161190	4:38463	Dep. NTIS, PC A04/MF A01

Report No.	Abstract No.	Availability
161192	4:38464	Dep. NTIS, PC A04/MF A01
DOE/NASA/TM-		
78219	4:38489	Dep. NTIS, PC A03/MF A01
78223	4:38490	Dep. NTIS, PC A02/MF A01
78225	4:38491	Dep. NTIS, PC A02/MF A01
DOE/TIC-		
10016	4:38365	Dep. NTIS, PC A03/MF A01
10043	4:39531	National Oceanic and Atmospheric Administration, Washington, DC
10045	4:39445	Dep. NTIS, PC A02/MF A01
10053(Vol.1)	4:38110	Dep. NTIS, PC A05/MF A01
10053(Vol.2)	4:38111	Dep. NTIS, MF A01
10053(Vol.3)	4:38112	Dep. NTIS, PC A04/MF A01
10053(Vol.4)	4:38113	Dep. NTIS, PC A05/MF A01
10053(Vol.5)	4:38114	Dep. NTIS, PC A04/MF A01
10053(Vol.6)	4:38115	Dep. NTIS, PC A04/MF A01
10053(Vol.7)	4:38116	Dep. NTIS, PC A05/MF A01
10053(Vol.8)	4:38117	Dep. NTIS, PC A02/MF A01
10062	4:38899	Dep. NTIS, PC A02/MF A01
10064	4:39008	Dep. NTIS, PC A04/MF A01
10065	4:38900	Dep. NTIS, PC A04/MF A01
10066	4:38901	Dep. NTIS, PC A02/MF A01
10071	4:38465	Dep. NTIS, PC A05/MF A01
10078	4:38158	Dep. NTIS, PC A06/MF A01
10089	4:38127	Dep. NTIS, PC A03/MF A01
10096	4:40034	Dep. NTIS, PC A02/MF A01
10097	4:40049	Dep. NTIS, PC A02/MF A01
10108	4:38861	Dep. NTIS, PC A06/MF A01
DOE-tr-		
138	4:39694	Dep. NTIS, PC A02/MF A01
DP-		
1501	4:39492	Dep. NTIS, PC A03/MF A01
1512	4:39613	Dep. NTIS, PC A03/MF A01
DP-MS-		
79-11	4:39707	Dep. NTIS, PC A02/MF A01
DPST-		
78-141-2	4:38207	*See* GJBX-43(79)
EML-		
353	4:39580	Dep. NTIS, PC A11/MF A01
ENDF-		
280	4:39900	*See* ORNL/TM-6637
EPA-		
625/9-77-002	4:38201	Environmental Research Information Center, Cincinnati, OH
EPRI-NP-		
920	4:39724	Dep. NTIS, PC A07/MF A01
EPRI-PS-		
952-SR	4:38929	Dep. NTIS, PC A14/MF A01
EPRI-WS-		
78-125	4:38736	Dep. NTIS, PC A10/MF A01
ESG-DOE-		
13254	4:38798	Dep. NTIS, PC A03/MF A01
FDA-		
79-8080	4:39701	GPO
FE-		
0496-T14	4:38073	Dep. NTIS, PC A04/MF A01
1207-49	4:38049	Dep. NTIS, PC A12/MF A01
1207-53	4:38050	Dep. NTIS, PC A06/MF A01
1747-1	4:38190	Dep. NTIS, PC A02/MF A01
1760-29	4:38957	Dep. NTIS, PC A04/MF A01
1775-18	4:38051	Dep. NTIS, PC A09/MF A01
1775-21	4:38052	Dep. NTIS, PC A07/MF A01
1784-42	4:38053	Dep. NTIS, PC A11/MF A01
1793-46	4:38054	Dep. NTIS, PC A09/MF A01
1806-65	4:38579	Dep. NTIS, PC A03/MF A01
2006-11	4:38055	Dep. NTIS, PC A05/MF A01
2047-9	4:38074	Dep. NTIS, PC A05/MF A01
2229-10	4:38056	Dep. NTIS, PC A04/MF A01
2229-11	4:38057	Dep. NTIS, PC A02/MF A01
2307-38	4:38075	Dep. NTIS, PC A02/MF A01
2346-34	4:38191	Dep. NTIS, PC A04/MF A01
2369-20	4:38058	Dep. NTIS, PC A06/MF A01
2489-27	4:38123	Dep. NTIS, PC A03/MF A01
2496-12	4:38059	Dep. NTIS, PC A06/MF A01
2496-26	4:38060	Dep. NTIS, PC A03/MF A01
2621-3	4:38061	Dep. NTIS, PC A03/MF A01
2721-2	4:38086	Dep. NTIS, PC A02/MF A01
2722-3	4:38118	Dep. NTIS, PC A02/MF A01
2765-T1	4:38062	Dep. NTIS, PC A03/MF A01
2781-3	4:38076	Dep. NTIS, PC A03/MF A01
2806-1	4:38063	Dep. NTIS, PC A05/MF A01
2893-16	4:38077	Dep. NTIS, PC A04/MF A01
9005-T1	4:38119	Dep. NTIS, PC A02/MF A01
FE-MIT-		
2295T26-6	4:38080	Dep. NTIS, PC A02/MF A01
FERMILAB-CONF-		
78/37-THY	4:39853	Dep. NTIS, PC A07/MF A01
78/73-THY	4:39861	Dep. NTIS, PC A04/MF A01
GA-A-		
14546	4:38799	Dep. NTIS, PC A05/MF A01
15159	4:38639	Dep. NTIS, PC A07/MF A01
GEFR-		
00414	4:38666	AT
00415	4:38800	AT
GEFR-SP-		
151	4:38667	Dep. NTIS, PC A02/MF A01
GJBX-		
33(79)	4:38206	Dep. NTIS PC E05/MF E05
43(79)	4:38207	Dep. NTIS, PC A03/MF A01
48(79)(Vol.2)(Atlin)	4:38208	Dep. NTIS, PC A05/MF A01
48(79)(Vol.2)(Bradfield)	4:38209	Dep. NTIS, PC A06/MF A01
48(79)(Vol.2)(Craig)	4:38210	Dep. NTIS, PC A06/MF A01
48(79)(Vol.2)(Juneau)	4:38211	Dep. NTIS, PC A07/MF A01
48(79)(Vol.2)(Ketchikan)	4:38212	Dep. NTIS, PC A06/MF A01
48(79)(Vol.2)(Petersburg)	4:38213	Dep. NTIS, PC A06/MF A01
48(79)(Vol.2)(Sitka)	4:38214	Dep. NTIS, PC A07/MF A01
48(79)(Vol.2)(Skagway)	4:38215	Dep. NTIS, PC A06/MF A01
48(79)(Vol.2)(Sumdum)	4:38216	Dep. NTIS, PC A06/MF A01
57(79)(Vol.2)(Charlotte)	4:38217	Dep. NTIS, PC A10/MF A01
57(79)(Vol.2)(Knoxville)	4:38218	Dep. NTIS, PC A12/MF A01
59(79)(Vol.2)(Prescott)	4:38219	Dep. NTIS, PC A17/MF A01
59(79)(Vol.2)(Williams)	4:38220	Dep. NTIS, PC A17/MF A01
GKSS-		
77/E/35	4:38786	ZAED
78/E/42	4:39542	Dep. NTIS (US Sales Only), PC A02/MF A01
GRS-F-		
54	4:38801	Dep. NTIS (US Sales Only), PC A03/MF A01
HCP/B8072-		
01	4:38930	Dep. NTIS, PC A07/MF A01
HCP/CS-		
4113-2	4:38466	Dep. NTIS, PC A16/MF A01
4113-3	4:38467	Dep. NTIS, PC A10/MF A01
HCP/M-		
2165	4:38902	Dep. NTIS, PC A06/MF A01
HCP/M2098-		
02	4:38591	Dep. NTIS, PC A03/MF A01
HCP/M4113-		
01	4:38468	Dep. NTIS, PC A03/MF A01
HCP/M5056-		
02	4:39040	Dep. NTIS, PC A07/MF A01
HCP/R4040-		
02	4:38366	Dep. NTIS, PC A12/MF A01
HCP/T1021-		
36	4:38528	Dep. NTIS, PC A04/MF A01
HCP/T2461-		
10	4:38124	Dep. NTIS, PC A02/MF A01
HEDL-SA-		
1329	4:38668	Dep. NTIS, PC A03/MF A01
1535-FP	4:38669	Dep. NTIS, PC A02/MF A01
1536-FP	4:38670	Dep. NTIS, PC A02/MF A01
1543-FP	4:38671	Dep. NTIS, PC A02/MF A01
1594-FP	4:40013	Dep. NTIS, PC A03/MF A01
1671	4:38778	Dep. NTIS, PC A04/MF A01
1683-FP	4:38672	Dep. NTIS, PC A02/MF A01
HEDL-TI-		
75002-33	4:38700	AT
75002-34	4:38701	AT
HEDL-TME-		
78-75	4:38780	*See* NUREG/CR-0643
78-93	4:38673	AT
78-102	4:39277	*See* NUREG/CR-0589
78-103	4:38754	Dep. NTIS, PC A04/MF A01
HI-		
79063	4:38836	*See* DOE/NASA/0038-79/1
HIT-		
687	4:39009	Dep. NTIS, PC A03/MF A01
689	4:38993	Dep. NTIS, PC A02/MF A01
690	4:39013	Dep. NTIS, PC A02/MF A01
691	4:39004	Dep. NTIS, PC A02/MF A01
692	4:39014	Dep. NTIS, PC A02/MF A01
HRP-		
0018641	4:39653	NTIS PCA02/MF A01
0900241	4:39654	Available from American College of Radiology, 6900 Wisconsin Ave., Chevy Chase, MD 20015.

Report No.	Abstract No.	Availability
IAEA-		
206	4:38712	Dep. NTIS (US Sales Only), PC A07/MF A01
209	4:38251	Dep. NTIS (US Sales Only), PC A05/MF A01
IAEA-SM-		
237/45	4:39667	*See* BNL-25730
237/57	4:39692	*See* BNL-25910
241-A1	4:39938	*See* LA-UR-79-533
IDO-		
1540-T1	4:38243	Dep. NTIS, PC A05/MF A01
1702-T1	4:39505	Dep. NTIS, PC A06/MF A01
INIS-mf-		
4125	4:40003	Dep. NTIS (US Sales Only), PC A13/MF A01
4324	4:40004	Dep. NTIS (US Sales Only), PC A03/MF A01
4403	4:39972	Dep. NTIS (US Sales Only), PC A06/MF A01
4426	4:38781	Dep. NTIS (US Sales Only), PC A10/MF A01
4492	4:38804	Dep. NTIS (US Sales Only), PC A02/MF A01
4494	4:38715	Dep. NTIS (US Sales Only), PC A02/MF A01
4521	4:38894	Dep. NTIS (US Sales Only), PC A11/MF A01
INS-		
867	4:38723	*See* INS-R-230
INS-R-		
230	4:38723	Dep. NTIS (US Sales Only), PC A03/MF A01
IS-		
4668	4:38044	Dep. NTIS, PC A05/MF A01
IS-M-		
192	4:38469	Dep. NTIS, PC A02/MF A01
IS-T-		
852	4:39801	Dep. NTIS, PC A06/MF A01
IVL-B-		
445	4:39614	Dep. NTIS (US Sales Only), PC A02/MF A01
449	4:39543	Dep. NTIS (US Sales Only), PC A03/MF A01
IWGFR-		
24-3	4:38678	Dep. NTIS (US Sales Only), PC A03/MF A01
JAERI-M-		
7453	4:38807	Dep. NTIS (US Sales Only), PC A02/MF A01
7503	4:38808	Dep. NTIS (US Sales Only), PC A02/MF A01
Juel-		
1433	4:38716	Dep. NTIS (US Sales Only), PC A03/MF A01
1490	4:38809	Dep. NTIS (US Sales Only), PC A08/MF A01
K/CSD/TM-		
29	4:40035	Dep. NTIS, PC A03/MF A01
K/OA-		
4488	4:38290	Dep. NTIS, PC A02/MF A01
K/UR-		
21(Pt.2)	4:38222	Dep. NTIS, PC A02/MF A01
KFA-AKI-IB-		
1/77	4:38810	Dep. NTIS (US Sales Only), PC A11/MF A01
KFK-		
2463	4:38304	Dep. NTIS (US Sales Only), PC A06/MF A01
2584	4:38679	Dep. NTIS (US Sales Only), PC A08/MF A01
2619	4:38680	Dep. NTIS (US Sales Only), PC A04/MF A01
KFK-EXT-		
15/78-1	4:38784	Dep. NTIS (US Sales Only), PC A05/MF A01
30/78-1	4:38762	Dep. NTIS (US Sales Only), PC A02/MF A01
KFK-tr-		
576	4:38682	Dep. NTIS (US Sales Only), PC A02/MF A01
LA-		
6915-MS	4:38128	Dep. NTIS, PC A03/MF A01
7445-C	4:39359	Dep. NTIS, PC A13/MF A01
7542	4:39237	Dep. NTIS, PC A02/MF A01
7602-MS	4:39221	Dep. NTIS, PC A02/MF A01
7610	4:38813	*See* NUREG/CR-0561
7633-M	4:40036	Dep. NTIS, PC A02/MF A01
7635-MS	4:38621	Dep. NTIS, PC A02/MF A01
7639-MS	4:39270	Dep. NTIS, PC A03/MF A01
7645-MS	4:38239	Dep. NTIS, PC A02/MF A01
7650-PR	4:39377	Dep. NTIS, PC A04/MF A01
7663-MS	4:39878	Dep. NTIS, PC A07/MF A01
7677-MS	4:40037	Dep. NTIS, PC A02/MF A01
7686-MS	4:40001	Dep. NTIS, PC A07/MF A01
7691-PR	4:39813	Dep. NTIS, PC A03/MF A01
7693-MS	4:38524	Dep. NTIS, PC A12/MF A01
7697	4:38202	Dep. NTIS, PC A02/MF A01
7700-MS	4:40038	Dep. NTIS, PC A02/MF A01
7704-PR	4:38724	Dep. NTIS, PC A04/MF A01
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7709-T	4:38641	Dep. NTIS, PC A09/MF A01
7717-M	4:38291	Dep. NTIS, PC A03/MF A01
7722-PR	4:39879	Dep. NTIS, PC A03/MF A01
7727-T	4:39793	Dep. NTIS, PC A11/MF A01
7759-MS	4:40009	Dep. NTIS, PC A03/MF A01
7783-MS	4:39288	Dep. NTIS, PC A04/MF A01
7785-MS	4:39145	Dep. NTIS, PC A02/MF A01
7817-MS(Vol.2)	4:39516	Dep. NTIS, PC A03/MF A01
LA-UR-		
78-2116	4:40039	Dep. NTIS, PC A02/MF A01
78-3062	4:39922	Dep. NTIS, PC A03/MF A01
78-3089	4:39731	Dep. NTIS, PC A02/MF A01
79-218	4:39802	Dep. NTIS, PC A03/MF A01
79-309	4:39738	Dep. NTIS, PC A02/MF A01
79-332	4:39258	Dep. NTIS, PC A02/MF A01
79-357	4:39841	Dep. NTIS, PC A02/MF A01
79-361	4:39863	Dep. NTIS, PC A02/MF A01
79-463	4:39446	Dep. NTIS, PC A02/MF A01
79-533	4:39938	Dep. NTIS, PC A03/MF A01
79-638	4:39885	Dep. NTIS, PC A02/MF A01
79-646	4:38188	Dep. NTIS, PC A02/MF A01
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79-658	4:39448	Dep. NTIS, PC A02/MF A01
79-665	4:38519	Dep. NTIS, PC A02/MF A01
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79-675	4:39289	Dep. NTIS, PC A02/MF A01
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79-714	4:39453	Dep. NTIS, PC A02/MF A01
79-723	4:38525	Dep. NTIS, PC A02/MF A01
79-750	4:39406	Dep. NTIS, PC A02/MF A01
79-751	4:39407	Dep. NTIS, PC A02/MF A01
79-839	4:39903	Dep. NTIS PC A02/MF A01
79-893	4:39832	Dep. NTIS, PC A02/MF A01
79-898	4:39454	Dep. NTIS, PC A02/MF A01
657	4:39408	Dep. NTIS, PC A02/MF A01
LBL-		
7038	4:39725	Dep. NTIS, PC A02/MF A01
7076	4:38518	Dep. NTIS, PC A04/MF A01
7091	4:38546	Dep. NTIS, PC A02/MF A01
7284	4:39544	Dep. NTIS, PC A02/MF A01
7294	4:39494	Dep. NTIS, PC A03/MF A01
7574	4:39475	Dep. NTIS, PC A17/MF A01
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7811	4:38470	Dep. NTIS, PC A15/MF A01
7841	4:38407	Dep. NTIS, PC A03/MF A01
7999	4:39545	Dep. NTIS, PC A02/MF A01
8208	4:39784	Dep. NTIS, PC A08/MF A01
8463	4:39887	Dep. NTIS, PC A09/MF A01
8548	4:39254	Dep. NTIS, PC A02/MF A01
8561	4:39865	Dep. NTIS, PC A08/MF A01
8613	4:39914	Dep. NTIS, PC A02/MF A01
8675	4:38526	Dep. NTIS, PC A02/MF A01
8758	4:39934	Dep. NTIS, PC A02/MF A01
8802	4:38512	Dep. NTIS, PC A02/MF A01
8808	4:39457	Dep. NTIS, PC A02/MF A01
8814	4:38471	Dep. NTIS, PC A02/MF A01
8818	4:39458	Dep. NTIS, PC A02/MF A01

Report No.	Abstract No.	Availability
8887	4:39479	Dep. NTIS, PC A02/MF A01
8892	4:38995	Dep. NTIS, PC A02/MF A01
8893	4:39010	Dep. NTIS, PC A02/MF A01
8900	4:40019	Dep. NTIS, PC A02/MF A01
8932	4:39795	Dep. NTIS, PC A02/MF A01
8936	4:39834	Dep. NTIS, PC A04/MF A01
8947	4:39459	Dep. NTIS, PC A02/MF A01
8975	4:39238	Dep. NTIS, PC A05/MF A01
9085	4:39702	Dep. NTIS, PC A02/MF A01
M-		
78-68(Vol.1)	4:38125	Dep. NTIS, PC A10/MF A01
100	4:39942	Dep. NTIS, PC A04/MF A01
METC/CR-		
79/5	4:39211	Dep. NTIS, PC A03/MF A01
MHSMP-		
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79-15	4:39200	Dep. NTIS, PC A02/MF A01
79-42	4:40040	Dep. NTIS, PC A02/MF A01
MIT-		
2295-1	4:38970	Dep. NTIS, PC A03/MF A01
MIT-EL-		
78-007	4:38377	Dep. NTIS, PC A07/MF A01
MLM-		
2595	4:38252	Dep. NTIS, PC A03/MF A01
2597	4:38820	*See* NUREG/CR-0740
2598(OP)	4:38506	Dep. NTIS, PC A02/MF A01
2600(TR)	4:39147	Dep. NTIS, PC A02/MF A01
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N-		
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78-27174	4:38985	NTIS PCA03/MF A01
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78-27706	4:39532	NTIS PCA03/MF A01
78-27915	4:39996	NTIS PCA02/MF A01
78-27916	4:39964	NTIS PCA03/MF A01
78-27917	4:39965	NTIS PCA02/MF A01
78-27965	4:39493	NTIS PCA04/MF A01
78-28024	4:39732	NTIS PCA02/MF A01
78-28025	4:39733	NTIS PCA02/MF A01
78-28027	4:39756	NTIS PCA06
78-28031	4:39744	NTIS PCA04/MF A01
78-28225	4:38126	NTIS PCA03/MF A01
78-28354	4:39271	NTIS PCA02/MF A01
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78-28601	4:38383	NTIS PCA03/MF A01
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78-28624	4:38849	NTIS PCA03/MF A01
78-28671	4:39633	NTIS PCA03/MF A01
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78-28954	4:39976	NTIS PCA05/MF A01
78-28993	4:39021	NTIS PCA03/MF A01
78-28994	4:39022	NTIS PCA12/MF A01
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78-29029	4:39747	NTIS PCA02/MF A01
78-29031	4:39729	NTIS PCA02/MF A01
78-30202	4:38473	NTIS PCA02/MF A01
78-30475	4:38403	NTIS PCA04/MF A01
78-30544	4:39503	NTIS PCA21/MF A01
78-30551	4:38311	NTIS PCA04/MF A01
78-30636	4:38098	NTIS PCA04/MF A01
78-30656	4:38384	NTIS PCA03/MF A01
78-30658	4:38385	NTIS PCA06/MF A01
78-30659	4:38386	NTIS PCA04/MF A01
78-30662	4:38387	NTIS PCA03/MF A01
78-30663	4:38406	NTIS PCA03/MF A01
78-30725	4:39549	NTIS PCA03/MF A01
78-30753	4:39764	NTIS PCA02/MF A01
78-30758	4:39757	NTIS PCA02/MF A01
78-30798	4:38324	NTIS PCA08/MF A01
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78-31021	4:39739	NTIS PCA02/MF A01
78-31027	4:39758	NTIS PCA03/MF A01
78-31028	4:39759	NTIS PCA03/MF A01
78-31030	4:39748	NTIS PCA02/MF A01
78-31031	4:39749	NTIS PCA07/MF A01
78-31033	4:39750	NTIS PCA04/MF A01
78-31038	4:39740	NTIS PCA02/MF A01
78-31040	4:39730	NTIS PCA03/MF A01
78-31043	4:39016	NTIS PCA03/MF A01
78-31085	4:39017	NTIS PCA10/MF A01
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78-31268	4:38197	NTIS PCA03/MF A01
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Report No.	Abstract No.	Availability
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NUREG-		
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NUREG/CR-		
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0495(Vol.2)	4:38265	NTIS, PC A07/MF A01
0495(Vol.3)	4:38266	NTIS, PC A07/MF A01
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0495(Vol.5)	4:38268	NTIS, PC A05/MF A01
0495(Vol.6)	4:38269	NTIS, PC A05/MF A01
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0513	4:38812	Dep. NTIS, PC A10/MF A01
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0697	4:38816	NTIS, PC A02/MF A01
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0702	4:38818	NTIS, PC A06/MF A01
0716	4:38819	Dep. NTIS, PC A02/MF A01
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0740	4:38820	NTIS, PC A03/MF A01
0746	4:38821	Dep. NTIS, PC A05/MF A01
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ORNL/TM-		
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6573	4:38254	AT
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6660	4:38302	Dep. NTIS, PC A03/MF A01
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4,130,369	4:39264	
4,130,671	4:39342	
4,137,267	4:39246	
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4,140,009	4:39061	
4,140,021	4:39273	
4,140,101	4:38994	
4,140,180	4:38195	
4,140,184	4:38317	
4,140,229	4:38122	
4,140,472	4:39348	
4,140,473	4:39346	

Report No.	Abstract No.	Availability
4,140,476	4:39347	
4,140,583	4:38069	
4,140,651	4:39356	
4,140,749	4:39086	
4,140,751	4:39357	
4,140,752	4:38607	
4,140,951	4:38108	
4,140,979	4:39303	
4,142,379	4:38999	
4,142,449	4:38107	
4,142,458	4:39035	
4,142,482	4:39060	
4,142,486	4:39069	
4,142,491	4:39055	
4,142,492	4:39083	
4,142,494	4:39070	
4,142,495	4:39084	
4,142,496	4:39085	
4,142,506	4:38998	
4,142,507	4:39006	
4,142,575	4:39001	
4,142,576	4:39002	
4,142,579	4:38577	
4,142,593	4:39280	
4,142,608	4:39059	
4,142,678	4:39000	
4,142,679	4:38997	
4,142,683	4:39068	
4,142,702	4:39301	
4,142,712	4:39345	
4,142,823	4:38333	
4,142,831	4:38586	
4,142,836	4:38587	
4,142,864	4:39081	
4,142,874	4:39354	
4,142,986	4:39300	
4,142,989	4:39355	
4,143,117	4:39082	
4,143,214	4:38856	
4,143,215	4:38857	
4,143,216	4:38855	
4,143,217	4:38854	
4,143,339	4:39302	
4,145,195	4:38088	
4,145,482	4:38853	
4,145,668	4:39298	
4,145,669	4:39299	
4,145,881	4:39080	
4,145,882	4:38558	
4,145,885	4:38559	
4,145,890	4:39358	
4,145,995	4:38580	
4,145,998	4:39058	
4,146,271	4:38105	
4,146,349	4:38106	
4,146,361	4:39042	
4,146,450	4:39353	
4,146,680	4:38844	
4,146,683	4:38850	
4,146,684	4:38851	
4,146,686	4:38852	
4,146,804	4:39272	
4,146,923	4:39015	
PB-		
283416	4:39171	NTIS PCA11/MF A01
283677	4:38163	NTIS PCA04/MF A01
283694	4:39043	NTIS PCA03/MF A01
283695	4:39044	NTIS PCA02/MF A01
283696	4:39552	NTIS PCA04/MF A01
283719	4:38164	NTIS PCA13/MF A01
283721	4:38494	NTIS PCA04/MF A01
283722	4:39005	NTIS PCA03/MF A01
283783	4:38495	NTIS PCA07/MF A01
283787	4:39634	NTIS PCA06/MF A01
283792	4:39351	NTIS PCA06/MF A01
283796	4:38042	NTIS PCA04/MF A01
283809	4:38865	NTIS PCA04/MF A01
283817	4:38186	NTIS PCA17/MF A01
283822	4:38876	NTIS PCA14/MF A01
283837	4:39604	NTIS PCA04/MF A01
283848	4:39632	NTIS PCA06/MF A01
283860	4:39051	NTIS PCA03/MF A01
283875	4:38178	NTIS PCA05/MF A01
283890	4:38165	NTIS PCA99/MF A01
283931	4:39023	NTIS PCA03/MF A01
283946	4:39024	NTIS PCA14/MF A01
283949	4:38862	NTIS PCA04/MF A01
283950	4:39033	NTIS PCA04/MF A01
283951	4:39034	NTIS PCA03/MF A01
283952	4:39025	NTIS PCA04/MF A01
283953	4:39056	NTIS PCA11/MF A01
283968	4:38877	NTIS PCA03/MF A01
283971	4:38918	NTIS PCA03/MF A01
283972	4:38131	NTIS PCA03/MF A01
283974	4:39026	NTIS PCA04/MF A01
283975	4:38179	NTIS PCA04/MF A01
283998	4:38391	NTIS PCA04/MF A01
284013	4:39616	NTIS PCA13/MF A01
284014	4:38878	NTIS PCA05/MF A01
284016	4:38099	NTIS PCA07/MF A01
284018	4:38938	NTIS PCA10/MF A01
284019	4:38143	NTIS PCA16/MF A01
284027	4:38199	NTIS PCA05/MF A01
284041	4:38066	NTIS PCA12/MF A01
284045	4:38602	NTIS PCA03/MF A01
284065	4:38166	NTIS PCA06/MF A01
284067	4:39011	NTIS PCA06/MF A01
284075	4:38593	NTIS PCA06/MF A01
284076	4:38594	NTIS PCA05/MF A01
284077	4:38595	NTIS PCA04/MF A01
284078	4:38596	NTIS PCA03/MF A01
284081	4:39585	NTIS PCA04/MF A01
284092	4:39652	
284094	4:38597	NTIS PCA07/MF A01
284095	4:39088	NTIS PCA16/MF A01
284103	4:38919	NTIS PCA99/MF A01
284111	4:39352	NTIS PCA04/MF A01
284138	4:38479	NTIS PCA03/MF A01
284145	4:38920	NTIS PCA13/MF A01
284164	4:39594	NTIS PCA09/MF A01
284196	4:38100	NTIS PCA06/MF A01
284198	4:39050	NTIS PCA10/MF A01
284200	4:39045	NTIS PCA12/MF A01
284211	4:39586	NTIS PCA10/MF A01
284213	4:39587	NTIS PCA99/MF A01
284214	4:38598	NTIS PCA05/MF A01
284221	4:38513	NTIS PCA04/MF A01
284227	4:38688	NTIS PCA22/MF A01
284228	4:38892	NTIS PCA03/MF A01
284297	4:38092	
284338	4:39553	
284375	4:38893	
284399	4:39527	NTIS PCA03/MF A01
284400	4:39554	NTIS PCA03/MF A01
284452	4:38603	
284611	4:38834	NTIS PCA03/MF A01
284676	4:38571	
284699	4:38305	NTIS PCA05/MF A01
284823	4:39555	
284826	4:39556	NTIS PCA15/MF A01
284827	4:39557	NTIS PCA06/MF A01
284841	4:38300	NTIS PCA02/MF A01
284850	4:39209	NTIS PCA03/MF A01
284866	4:39558	NTIS PCA04/MF A01
284905	4:39559	NTIS PCA04/MF A01
284938	4:39560	NTIS PCA03/MF A01
284941	4:39027	NTIS PCA14/MF A01
284973	4:39561	NTIS PCA15/MF A01
284974	4:39562	NTIS PCA06/MF A01
285041	4:38101	NTIS PCA05/MF A01
285059	4:39563	NTIS PCA04/MF A01
285062	4:38921	NTIS PCA04/MF A01
285072	4:39597	NTIS PCA06/MF A01
285096	4:38102	NTIS PCA08/MF A01
285098	4:38600	NTIS PCA99/MF A01
285117	4:38303	NTIS PCA02/MF A01
285122	4:38103	NTIS PCA06/MF A01
285123	4:38612	NTIS PCA04/MF A01
285126	4:38574	NTIS PCA04/MF A01
285129	4:38358	NTIS PCA08/MF A01
285130	4:39697	NTIS PCA99/MF A01
285131	4:38895	NTIS PCA07/MF A01
285165	4:38763	NTIS PCA09/MF A01
285190	4:38613	NTIS PCA03/MF A01
285197	4:38866	NTIS PCA03/MF A01
285198	4:38867	NTIS PCA05/MF A01
285211	4:38167	NTIS PCA04/MF A01
285227	4:39564	NTIS PCA06/MF A01
285251	4:38120	NTIS PCA14/MF A01
285260	4:38931	NTIS PCA99/MF A01

Report No.	Abstract No.	Availability
285381	4:39057	NTIS PCA02/MF A01
285382	4:39064	NTIS PCA03/MF A01
285397	4:38575	NTIS PCA07/MF A01
285408	4:38168	NTIS PCA05/MF A01
285409	4:38169	NTIS PCA13/MF A01
285410	4:39609	NTIS PCA05/MF A01
285429	4:39565	NTIS PCA13/MF A01
285430	4:39566	NTIS PCA07/MF A01
285437	4:39046	NTIS PCA09/MF A01
285438	4:39201	NTIS PCA02/MF A01
285440	4:39693	NTIS PCA04/MF A01
285447	4:38093	NTIS PCA14/MF A01
285452	4:39212	NTIS PCA04/MF A01
285491	4:38159	NTIS PCA04/MF A01
285508	4:38903	NTIS PCA12/MF A01
285510	4:38904	NTIS PCA03/MF A01
285566	4:38942	NTIS PCA04/MF A01
285611	4:39079	NTIS PCA05/MF A01
285628	4:39664	NTIS PCA04/MF A01
285642	4:38863	NTIS PCA15/MF A01
285646	4:39617	
285656	4:39052	NTIS PCA10/MF A01
285662	4:39567	NTIS PCA07/MF A01
285679	4:38170	NTIS PCA03/MF A01
285709	4:39041	NTIS PCA05/MF A01
285713	4:38879	NTIS PCA12/MF A01
285723	4:38604	NTIS PCA05/MF A01
285746	4:38880	NTIS PCA04/MF A01
285747	4:38881	NTIS PCA03/MF A01
285748	4:38882	NTIS PCA07/MF A01
285749	4:38883	NTIS PCA07/MF A01
285750	4:38884	NTIS PCA07/MF A01
285751	4:38885	NTIS PCA10/MF A01
285773	4:39752	
285774	4:39753	
285781	4:38413	NTIS PCA04/MF A01
285793	4:39703	NTIS PCA03/MF A01
285797	4:39047	NTIS PCA20/MF A01
285801	4:38160	NTIS PCA02/MF A01
285805	4:39618	
285815	4:38886	NTIS PCA06/MF A01
285827	4:38936	NTIS PCA05/MF A01
285854	4:38605	NTIS PCA02/MF A01
285869	4:38868	NTIS PCA03/MF A01
285870	4:38869	NTIS PCA07/MF A01
285880	4:38045	NTIS PCA05/MF A01
285924	4:38576	NTIS PCA16/MF A01
285931	4:38171	NTIS PCA05/MF A01
285938	4:38287	NTIS PCA03/MF A01
285941	4:38203	NTIS PCA05/MF A01
285944	4:38129	NTIS PCA15/MF A01
285966	4:39497	NTIS PCA06/MF A01
285980	4:39568	NTIS PCA13/MF A01
286002	4:38887	NTIS PCA03/MF A01
286006	4:38132	NTIS PCA02/MF A01
286024	4:38599	NTIS PCA15/MF A01
286034	4:38223	NTIS PCA12/MF A01
286038	4:38888	NTIS PCA05/MF A01
286050	4:39048	NTIS PCA03/MF A01
286074	4:38983	NTIS PCA03/MF A01
286075	4:39065	NTIS PCA03/MF A01
286076	4:39066	NTIS PCA04/MF A01
286077	4:39067	NTIS PCA03/MF A01
286113	4:39695	NTIS PCA02/MF A01
286217	4:39619	NTIS PCA09/MF A01
286229	4:39569	NTIS PCA05/MF A01
286322	4:39570	NTIS PCA07/MF A01
286346	4:39728	NTIS PCA05/MF A01
286483	4:39202	NTIS PCA08/MF A01
286485	4:39571	NTIS PCA12/MF A01
286520	4:38224	NTIS PCA18/MF A01
286646	4:38606	NTIS PCA05/MF A01
286671	4:38554	NTIS PCA02/MF A01
286716	4:38323	NTIS PCA02/MF A01
286722	4:38318	NTIS PCA14/MF A01
286739	4:38332	NTIS PCA14/MF A01
286773	4:39767	NTIS PCA02/MF A01
286869	4:38293	NTIS PCA03/MF A01
286988	4:38104	NTIS PCA05/MF A01
287140	4:39598	NTIS PCA08/MF A01
PNL-		
1948	4:38271	Dep. NTIS, PC A04/MF A01
2410-1(Rev.)	4:38912	Dep. NTIS, PC A17/MF A01
2457	4:38246	Dep. NTIS, PC A09/MF A01
2690	4:38255	Dep. NTIS, PC A04/MF A01
2692	4:38750	*See* NUREG/CR-0220
2738	4:38971	Dep. NTIS, PC A07/MF A01
2740	4:39605	Dep. NTIS, PC A02/MF A01
2805	4:39167	Dep. NTIS, PC A03/MF A01
2809	4:38256	Dep. NTIS, PC A08/MF A01
2810	4:38408	Dep. NTIS, PC A03/MF A01
2829	4:39572	Dep. NTIS, PC A07/MF A01
PNL-RAP-		
33	4:39657	Dep. NTIS, PC A10/MF A01
PPPL-		
1517	4:40008	Dep. NTIS, PC A04/MF A01
1521	4:40020	Dep. NTIS, PC A03/MF A01
1534	4:39980	Dep. NTIS, PC A03/MF A01
1537	4:40006	Dep. NTIS, PC A02/MF A01
1538	4:39973	Dep. NTIS, PC A02/MF A01
RAND-P-		
6115	4:38896	Rand Corp., Santa Monica, CA
RAND/R-		
2278-DWP/NSF	4:38932	Dep. NTIS, PC A06/MF A01
RD-B-N-		
4079	4:38725	Dep. NTIS (US Sales Only), PC A07/MF A01
RDA-TR-		
108600-001	4:39796	*See* UCRL-13965
REG/G-		
7.9	4:39278	Nuclear Regulatory Commission, Washington, DC
RFP-		
2835	4:38257	Dep. NTIS, PC A02/MF A01
2886	4:38241	Dep. NTIS, PC A03/MF A01
2887	4:38242	Dep. NTIS, PC A02/MF A01
2902	4:40041	Dep. NTIS, PC A02/MF A01
RHO-BWI-		
79-100-1Q	4:38272	Dep. NTIS, PC A04/MF A01
RHO-CD-		
271	4:38247	Dep. NTIS, PC A03/MF A01
RISO-		
373	4:38627	Dep. NTIS (US Sales Only), PC A04/MF A01
RISO-M-		
2132	4:38726	Dep. NTIS (US Sales Only), PC A03/MF A01
RLO-		
78-5	4:38399	Dep. NTIS, PC A10/MF A01
223/T4-207	4:39852	*See* DOE/ER/70004-207
1830-T1	4:39029	Dep. NTIS, PC A06/MF A01
2225-T26-58	4:39611	*See* DOE/EV-75027-58
2227/T25-3	4:39657	*See* PNL-RAP-33
2230-T4-218	4:39858	*See* DOE/ER/70004-218
RS-		
120/77	4:38743	*See* SGAE-2820
SAI-		
068-79-516	4:38121	Dep. NTIS, PC A11/MF A01
SAN-		
1137-10	4:38543	Dep. NTIS, PC A06/MF A01
1137-11	4:38540	Dep. NTIS, PC A07/MF A01
1189-3	4:38144	Dep. NTIS, PC A05/MF A01
1265-8	4:38133	Dep. NTIS, PC A04/MF A01
1286-4	4:38392	Dep. NTIS, PC A06/MF A01
1543-12	4:38592	Dep. NTIS, PC A05/MF A01
1608-4-2	4:38409	Dep. NTIS, PC A06/MF A01
SAND-		
76-0347	4:38496	Dep. NTIS, PC A14/MF A01
78-0261C	4:38823	Dep. NTIS, PC A02/MF A01
78-0400	4:38294	Dep. NTIS, PC A03/MF A01
78-0681	4:38480	Dep. NTIS, PC A03/MF A01
78-0977	4:38497	Dep. NTIS, PC A04/MF A01
78-0982	4:38498	Dep. NTIS, PC A03/MF A01
78-1198	4:39191	Dep. NTIS, PC A02/MF A01
78-1342	4:39507	Dep. NTIS, PC A06/MF A01
78-1364	4:38847	Dep. NTIS, PC A02/MF A01
78-1523C	4:39338	Dep. NTIS, PC A02/MF A01
78-1584C	4:39279	Dep. NTIS, PC A02/MF A01
78-1620	4:38562	Dep. NTIS, PC A05/MF A01
78-1731C	4:39518	Dep. NTIS, PC A03/MF A01
78-1769	4:38499	Dep. NTIS, PC A04/MF A01
78-1859C	4:39339	Dep. NTIS, PC A02/MF A01
78-2074C	4:38824	Dep. NTIS, PC A02/MF A01
78-2242	4:40029	Dep. NTIS, PC A03/MF A01
78-2268C	4:38189	Dep. NTIS, PC A02/MF A01
78-7034	4:38500	Dep. NTIS, PC A15/MF A01
78-7076	4:39726	Dep. NTIS, PC A08/MF A01
78-8047	4:39326	Dep. NTIS, PC A03/MF A01
79-0013C	4:38527	Dep. NTIS, PC A02/MF A01

Report No.	Abstract No.	Availability
79-0027	4:39519	Dep. NTIS, PC A02/MF A01
79-0056	4:38180	Dep. NTIS, PC A06/MF A01
79-0115	4:39727	Dep. NTIS, PC A05/MF A01
79-0186	4:38295	Dep. NTIS, PC A02/MF A01
79-0240	4:39704	Dep. NTIS, PC A03/MF A01
79-0246C	4:38507	Dep. NTIS, PC A02/MF A01
79-0329	4:39260	Dep. NTIS, PC A03/MF A01
79-0352C	4:39093	Dep. NTIS, PC A02/MF A01
79-0382	4:39810	Dep. NTIS, PC A03/MF A01
79-0388C	4:39340	Dep. NTIS, PC A02/MF A01
79-0396C	4:38614	Dep. NTIS, PC A02/MF A01
79-0413C	4:39179	Dep. NTIS, PC A03/MF A01
79-0431	4:38564	Dep. NTIS, PC A04/MF A01
79-0458C	4:40042	Dep. NTIS, PC A03/MF A01
79-0497C	4:39168	Dep. NTIS, PC A02/MF A01
79-0505	4:38078	Dep. NTIS, PC A04/MF A01
79-0515	4:38501	Dep. NTIS, PC A03/MF A01
79-0562	4:38145	Dep. NTIS, PC A03/MF A01
79-0596C	4:39461	Dep. NTIS, PC A02/MF A01
79-0636C	4:39128	Dep. NTIS, PC A02/MF A01
79-0727C	4:39094	Dep. NTIS, PC A02/MF A01
79-0746C	4:38192	Dep. NTIS, PC A02/MF A01
79-0796	4:39705	Dep. NTIS, PC A04/MF A01
79-0922C	4:39095	Dep. NTIS, PC A02/MF A01
79-2076C	4:39177	Dep. NTIS, PC A02/MF A01
SERI-		
22	4:38481	Dep. NTIS, PC A05/MF A01
SERI/SP-		
11-142	4:38352	Solar Energy Research Inst., Golden, CO
33-140	4:39090	Dep. NTIS, PC A15/MF A01
SERI/TP-		
51-158	4:38563	Dep. NTIS, PC A02/MF A01
53-123	4:38367	Dep. NTIS, PC A03/MF A01
SERI/TR-		
33-122	4:38309	Dep. NTIS, PC A06/MF A01
51-160	4:38361	Dep. NTIS, PC A04/MF A01
51-161	4:38353	Dep. NTIS, PC A03/MF A01
51-162	4:38362	Dep. NTIS, PC A03/MF A01
62-148	4:38368	Dep. NTIS, PC A04/MF A01
SGAE-		
2820	4:38743	Dep. NTIS (US Sales Only), PC A03/MF A01
2875	4:38258	Dep. NTIS (US Sales Only), PC A02/MF A01
SLAC-PUB-		
2218	4:39815	Dep. NTIS, PC A04/MF A01
2255	4:39480	Dep. NTIS, PC A02/MF A01
2258	4:39481	Dep. NTIS, PC A02/MF A01
2262	4:39482	Dep. NTIS, PC A03/MF A01
2265	4:39483	Dep. NTIS, PC A02/MF A01
2266	4:39462	Dep. NTIS, PC A02/MF A01
2267	4:39484	Dep. NTIS, PC A02/MF A01
2270	4:39485	Dep. NTIS, PC A02/MF A01
2298	4:39856	Dep. NTIS, PC A04/MF A01
SLAC-TN-		
79-1	4:39711	Dep. NTIS, PC A03/MF A01
SRI-		
7406-4	4:38244	*See* NUREG/CR-0558
SRO-		
0870-5	4:39658	Dep. NTIS, PC A02/MF A01
STAN-CS-		
79-719	4:40043	*See* SU-326-P30-61
STI/PUB-		
471(Vol.2)	4:39665	IAEA, $31.00
SU-		
326-P30-61	4:40043	Dep. NTIS, PC A04/MF A01
TAC-STC-		
78-003	4:38414	Univ. of New Mexico, Albuquerque, NM
TAC-STHC-		
78-003	4:38482	Univ. of New Mexico, Albuquerque, NM
TECHNICATOME-CONF-		
77-1	4:38718	Dep. NTIS (US Sales Only), PC A02/MF A01
TFBP-TR-		
279	4:38825	Dep. NTIS, PC A03/MF A01
TID-		
28953	4:38067	Dep. NTIS, PC A03/MF A01
28955	4:38193	Dep. NTIS, PC A02/MF A01
28958	4:38194	Dep. NTIS, PC A04/MF A01
29304	4:38068	Dep. NTIS, PC A03/MF A01
29389	4:38864	Dep. NTIS, PC A04/MF A01
29393	4:38870	Dep. NTIS, PC A08/MF A01
29425(Vol.1)	4:38094	Dep. NTIS, PC A05/MF A01
29425(Vol.2)	4:38095	Dep. NTIS, PC A15/MF A01
TR-		
1210-1(Vol.1)	4:38264	*See* NUREG/CR-0495(Vol.1)
1210-1(Vol.2)	4:38265	*See* NUREG/CR-0495(Vol.2)
1210-1(Vol.3)	4:38266	*See* NUREG/CR-0495(Vol.3)
1210-1(Vol.4)	4:38267	*See* NUREG/CR-0495(Vol.4)
1210-1(Vol.5)	4:38268	*See* NUREG/CR-0495(Vol.5)
1210-1(Vol.6)	4:38269	*See* NUREG/CR-0495(Vol.6)
1210-1(Vol.7)	4:38270	*See* NUREG/CR-0495(Vol.7)
TREE-		
1340	4:38530	Dep. NTIS, PC A04/MF A01
UCB/EERC-		
79/08	4:38826	Dep. NTIS, PC A10/MF A01
UCID-		
17958	4:38634	Dep. NTIS, PC A02/MF A01
18030	4:39960	Dep. NTIS, PC A02/MF A01
18072	4:39946	Dep. NTIS, PC A02/MF A01
18077	4:39187	Dep. NTIS, PC A02/MF A01
18089	4:39974	Dep. NTIS, PC A02/MF A01
18101	4:38273	Dep. NTIS, PC A03/MF A01
18103	4:38274	Dep. NTIS, PC A02/MF A01
18151	4:39210	Dep. NTIS, PC A04/MF A01
18156	4:40002	Dep. NTIS, PC A03/MF A01
18160	4:39261	Dep. NTIS, PC A03/MF A01
18161	4:39806	Dep. NTIS, PC A02/MF A01
18165	4:39520	Dep. NTIS, PC A02/MF A01
18170	4:39262	Dep. NTIS, PC A02/MF A01
UCLA-		
12-1190	4:39595	Dep. NTIS, PC A03/MF A01
UCRL-		
13950	4:39773	Dep. NTIS, PC A03/MF A01
13965	4:39796	Dep. NTIS, PC A03/MF A01
13970	4:38859	Dep. NTIS, PC A05/MF A01
50036-78-4	4:38181	Dep. NTIS, PC A03/MF A01
50050-78	4:38275	Dep. NTIS, PC A03/MF A01
52000-79-3	4:39293	Dep. NTIS, PC A03/MF A01
52434(Vol.4)	4:39182	Dep. NTIS, PC A02/MF A01
52521	4:40014	Dep. NTIS, PC A03/MF A01
52532(Vol.4)(Pt.1)	4:39203	Dep. NTIS, PC A03/MF A01
52594	4:39204	Dep. NTIS, PC A03/MF A01
52624	4:38821	*See* NUREG/CR-0746
52640	4:38545	Dep. NTIS, PC A02/MF A01
52657	4:39498	Dep. NTIS, PC A02/MF A01
52665	4:39714	Dep. NTIS, PC A03/MF A01
52667	4:39962	Dep. NTIS, PC A02/MF A01
52669	4:39582	Dep. NTIS, PC A02/MF A01
52681	4:39706	Dep. NTIS, PC A04/MF A01
52708	4:38827	Dep. NTIS, PC A03/MF A01
81707	4:38182	Dep. NTIS, PC A02/MF A01
81834	4:39423	Dep. NTIS, PC A02/MF A01
81879	4:39103	Dep. NTIS, PC A04/MF A01
81896	4:40015	Dep. NTIS, PC A02/MF A01
81909	4:39923	Dep. NTIS, PC A02/MF A01
82057(Rev.1)	4:39736	Dep. NTIS, PC A03/MF A01
82120	4:40016	Dep. NTIS, PC A02/MF A01
82159	4:39169	Dep. NTIS, PC A02/MF A01
82181	4:39255	Dep. NTIS, PC A03/MF A01
82272	4:39981	Dep. NTIS, PC A02/MF A01
82358	4:39509	Dep. NTIS, PC A02/MF A01
82436	4:39327	Dep. NTIS, PC A02/MF A01
82528	4:39096	Dep. NTIS, PC A02/MF A01
82542	4:39533	Dep. NTIS, PC A02/MF A01
82549	4:39573	Dep. NTIS, PC A02/MF A01
UCRL-Trans-		
11468	4:39809	Dep. NTIS, PC A03/MF A01
11471	4:39948	Dep. NTIS, PC A03/MF A01
11473	4:39803	Dep. NTIS, PC A03/MF A01
UH-		
511-329-79	4:39872	Dep. NTIS, PC A02/MF A01
511-330-79	4:39835	Dep. NTIS, PC A02/MF A01
UILU-ENG-		
79-1704	4:40031	*See* COO-2383-0056
UNI-		
1197	4:38785	Dep. NTIS, PC A02/MF A01
UR-		
3490-1480	4:39649	Dep. NTIS, PC A03/MF A01
3490-1553	4:39650	Dep. NTIS, PC A02/MF A01
3490-1568	4:39659	Dep. NTIS, PC A02/MF A01
3490-1569	4:39637	Dep. NTIS, PC A02/MF A01
3490-1573	4:39244	Dep. NTIS, PC A03/MF A01
3490-1574	4:39245	Dep. NTIS, PC A03/MF A01
3490-1578	4:39638	Dep. NTIS, PC A03/MF A01

UWFDM-		
227	4:39966	Dep. NTIS, PC A07/MF A01
288	4:40007	Dep. NTIS, PC A02/MF A01
WCAP-		
9104	4:38228	Dep. NTIS, PC A08/MF A01
9104(Add.1)	4:38229	Dep. NTIS, PC A04/MF A01
9104(Add.2)	4:38230	Dep. NTIS, PC A03/MF A01
9104(Add.3)	4:38231	Dep. NTIS, PC A05/MF A01
9128	4:38296	Dep. NTIS, PC A03/MF A01
9144	4:38232	Dep. NTIS, PC A03/MF A01
9189	4:38233	Dep. NTIS, PC A05/MF A01
9200	4:38234	Dep. NTIS, PC A05/MF A01
9278	4:38235	Dep. NTIS, PC A06/MF A01
9282	4:38236	Dep. NTIS, PC A05/MF A01
9293	4:38237	Dep. NTIS, PC A03/MF A01
9344	4:38297	Dep. NTIS, PC A03/MF A01
9345	4:38298	Dep. NTIS, PC A03/MF A01
9422	4:38238	Dep. NTIS, PC A05/MF A01
Y-		
2180	4:39263	Dep. NTIS, PC A02/MF A01
Y/DA-		
7109	4:39510	Dep. NTIS, PC A02/MF A01
7999	4:38299	Dep. NTIS, PC A02/MF A01
8220	4:39049	Dep. NTIS, PC A02/MF A01
8239	4:39097	Dep. NTIS, PC A02/MF A01

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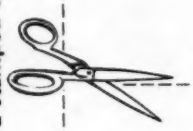

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